

UNITED STATES OF AMERICA:  
WAR DEPARTMENT.

---

# MONTHLY WEATHER REVIEW.

(GENERAL WEATHER SERVICE OF THE UNITED STATES.)

SEPTEMBER, 1886.

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PREPARED UNDER THE DIRECTION OF  
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PUBLISHED BY AUTHORITY OF THE SECRETARY OF WAR.

WASHINGTON CITY:  
SIGNAL OFFICE.  
1886.

List of merchant marine steam and sailing vessels from which International Simultaneous Meteorological reports were received at the Office of the Chief Signal Officer, U. S. Army, Washington, D. C., in time to be used in the preparation of the Weather Review for the month of September, 1886.

Name of vessel.	Captain.	Name of vessel.	Captain.	Name of vessel.	Captain.
<i>Allen Line.</i>		<i>Navigazione Generale Italiana.</i>		<i>New York Herald Weather Service—Cont.</i>	
Br. s. c. Canadian	Capt. J. Kerr.	It. s. c. Polcevera	Capt. Jon. Brofferio.	Br. s. c. Angerton	Capt. S. M. Orr
Circusian	Wm. Richardson.	<i>New York and Cuba Mail S. S. Co.</i>	F. M. Faircloth.	Aurania	W. H. P. Hains.
Crescent	C. E. LeGallais.	Am. s. s. Glenfuegos	J. W. Reynolds.	San. Brooks	J. Harrison.
Hibernian	John Brown.	N. Y. s. s. Havana & Mexico Mail S. S. Co.	W. M. Rittig.	Assyrian Monarch	Geo. Burton.
Manitoba	R. Carruthers.	Am. s. c. City of Alexandria	H. Bodeker.	Baltic	W. A. Beynon.
Nova Scotia	R. H. Hughes.	City of Washington	H. Swamer.	Belgian	Dutton.
Prussia	Alex. McDougall.	<i>North German Lloyd Steamship Co.</i>	H. Christoffers.	Britannic	P. J. Irving.
<i>American Line.</i>		Ger. s. c. America	T. Jungst.	Buffalo	W. H. Mahor.
Br. s. c. British King	John Kelly.	Donau	U. Ring.	Celtic	B. Gladell.
British Prince	R. H. French.	Elbe	Kohlmann.	Clenfuegos	F. M. Faircloth.
Indiana	R. W. Sargent.	Elms	H. Sander.	Caracas	Hopkins.
Lord Clive	P. Urquhart.	Fulda	H. Reichter.	Cincinnati	A. Campbell.
Ocean Prince	W. J. Milburn.	Hermann	W. Willigerod.	City of Alexandria	J. W. Reynolds.
<i>Anchor Line.</i>		Main	H. Bruns.	City of Berlin	F. S. Land.
Br. s. c. Anchor	J. J. Small.	Saale		City of Chester	H. Condon.
British Crown	Archibald Smith.	Trave		City of Chicago	F. Watkins.
Circusian	A. Campbell.	Weser		City of Friburg	Deaken.
City of Rome	R. D. Harris.	<i>Ocidental &amp; Oriental S. S. Co.</i>	W. G. Pearne.	City of Rome	R. D. Munro.
Devonia	Hugh Young.	Br. s. c. Gallie	J. W. Catharine.	City of Washington	W. H. Rittig.
Dorian	J. McKean.	Am. s. c. Chattahoochee	K. S. Nickerson.	Charlton	T. M. MacKnight.
Fortuna	J. Hedderwick.	City of Augusta	Ch. Off. Edwards.	Colon	Chas. C. Lima.
Ethiopia	John Wilson.	City of Savannah	Capt. H. M. Hayward.	Comal	Bolger.
Trinacria	Geo. Mitchell.	<i>Atlantic Steamship Company.</i>	Frank Stevens.	Craighill	W. H. Bennett.
<i>Atlas Line.</i>		Am. s. c. Mariposa	Fred Bolles.	Donau	H. Swamer.
Sp. s. c. Alpen	T. Anneaganti.	Old Dominion Steamship Company.	E. Polemann.	Elder	J. H. Bennett.
Alvora	T. M. MacKnight.	Am. s. c. Manhattan	G. Dohney.	Edith Golden	J. Sumner.
Charbel	Thomas Dury.	Oregon Railway and Navigation Co.	R. B. Searle.	Egypt	Morgan.
<i>Dodge's S. S. Co. (United).</i>		Am. s. c. Columbia	W. B. Cobb.	Egyptian Monarch	Quick.
Br. s. c. Cleburn	C. Journeil.	Oregon	J. M. Caverly.	El Paso	J. Robinson.
<i>Hardaway Steam Navigation Company.</i>		Pacific Coast Steamship Company.	W. B. Cobb.	Elin	J. Wilson.
Br. s. c. Chateau Yquem	W. Fitt.	Am. s. c. State of California	G. Dohney.	Ethiopia	T. Cook.
Br. s. c. Brooklyn City	T. L. Weiss.	Pacific Mail Steamship Company.	W. B. Searle.	Etruria	W. Willigerod.
Br. s. c. Wells City	H. B. Freeman.	Am. s. c. City of New York	W. B. Cobb.	Enns	R. B. Quick.
Br. s. c. Concord	E. V. Gager.	City of Rio de Janeiro	J. M. Caverly.	Fulda	R. Ring.
<i>Consolidated Line.</i>		Colins	Chas. C. Lima.	Gellert	W. Kulewein.
Br. s. c. Aetna	W. H. P. Hains.	Granada	W. B. Seabury.	Greece	A. J. Jeffrey.
Catalonia	Henry Walker.	San Blas	T. Chapman.	Hudson	Freeman.
Cephalonia	T. Cook.	<i>Quebec Steamship Company.</i>	G. S. Locke.	Hannonia	H. F. Schwensen.
Etruria	M. Murphy.	Br. s. c. Muriel	J. S. Garvin.	Hoboln	T. J. Farrell.
Gallia	B. Woodford.	Orinoco	W. J. Fraser.	La Bourgogne	Frangul.
Pavonia	T. Roberts.	Trinidad	San. Hess.	La Bretagne	de Jonnelin.
Scythia	H. McKay.	Red "D" Line.	W. H. Ellis.	La Champagne	Traub.
Scythia	W. McKean.	Red Cross Line.	W. A. Beynon.	La Normandie	de Kervabec.
Umbria	Julius Bahr.	Br. s. c. Capulet	Rud. Weyer.	Lampas	Mason.
<i>Edward &amp; Co's S. S. Line.</i>		Belgium	J. C. Jamison.	Long Star	Gager.
Ger. s. c. Amal	G. Frank.	Pennland	H. Buschmann.	Louisiana	T. C. Huggett.
Australia	A. Kuhn.	Rhynland	J. C. Jamison.	Lylian Monarch	F. Stevens.
Polynesia	F. Verriers.	Switzerland	H. Ueberw.	Miranda	Bendon.
<i>Fish Line.</i>		Wassland	Com. W. G. Randle.	Nevada	J. Douglas.
Br. s. c. Neustria	F. Manley.	Westernland	Capt. J. H. Taat.	Newport	W. C. Shuckford.
<i>Payson Line.</i>		Rotterdam Line.	T. H. Bonjer.	Nigeria	H. E. Nichols.
Br. s. c. Portland	M. P. Lund.	Edam	A. Potjer.	Noordland	J. S. Garvin.
Durham City	M. de Kervabec.	P. Caland	G. Moonie.	Orinoco	Ripth.
<i>General Trans-Atlantic Steamship Co.</i>		Schiedam	A. J. A. Mann.	P. Calland	Bonjer.
Br. s. c. La Bourgogne	M. de Kervabec.	Zaandam	A. G. Brues.	Philadelphia	H. Weyer.
La Bretagne	G. de Kervabec.	State Line.	H. von der Zee.	Portia	Bess.
La Champagne	G. de Kervabec.	Br. s. c. State of Georgia	A. G. Brues.	Rhein	H. Dawson.
La Normandie	G. de Kervabec.	State of Pennsylvania	W. Skjott.	Rhynland	C. Wigan.
<i>Grand Western S. S. Line.</i>		State of Nebraska	S. T. H. Lamb.	Rio Grande	J. C. Jamison.
Br. s. c. Dorset	Ch. Off. E. Crossman.	Thingwall Line.	A. Hyde.	Schiedam	G. Bakker.
<i>Gull Line.</i>		Br. s. c. Hecla	Samuel Walters.	Servia	A. McKay.
Br. s. c. Alaska	Capt. G. O. Murray.	Island	W. Gleig.	State of Nebraska	A. G. Brues.
Arctica	John Douglas.	Thingwall	E. Maddox.	State of Pennsylvania	A. J. A. Mann.
Nevada	Edward Bentley.	Twain River Line.	S. R. Chandler.	Switzerland	H. Buschmann.
Wacoma	C. L. Rigby.	Br. s. c. Richmond Hill	H. Meyer.	Travel	W. Willigerod.
Wyoming	R. Kurlawa.	Warren Line.	H. Parsell.	Umbria	W. McKean.
<i>Humbert &amp; American Line.</i>		Br. s. c. Iowa	George Burton.	Valencia	Woodrich.
Ger. s. c. Bohemia	W. Kulewein.	Kansas	B. Perry.	Warwick	G. J. Vis.
Hannonia	H. F. Schwensen.	Weserman	W. Abbott.	Wassland	J. Ueberw.
Emilia	H. Barends.	Wells Ward Line.	P. L. Reimers.	Westernland	Com. W. G. Randle.
Kharta	H. Vogelwang.	Br. s. c. Camden	S. M. Orr.	Wisconsin	Capt. E. Bentley.
Rugia	A. Alberts.	White Cross Line.	W. H. Bennett.	<i>Sailing vessels.</i>	
Wieland	C. Heibich.	Br. s. c. Jan Breydel	John W. Harvey.	Br. bk. Abyssinian	John Hughes.
Westphalia	Droscher.	White Star Line.	John H. Bennett.	Am. bk. Abbie Clifford	D. W. Storer.
<i>Imma Line.</i>		Br. s. c. Adriatic	T. Scholts.	Br. bk. Ada Pearl	Nath. Hocken.
Br. s. c. City of Berlin	Francis S. Land.	Baltic	D. Robertson.	Br. bk. Alvera	J. H. Welden.
City of Chester	A. Lewis.	Britannic	Henry Gibb.	Ger. bk. Arnold Von Bippen	C. Gallus.
<i>Lampert &amp; Holt's Steamship Company.</i>		Celtic	Rich'd Webster.	Am. bk. Charles R. Lewis	T. Moller.
Br. s. c. Boreal	Chas. J. Watson.	Wilson Line.	A. de Mugen.	Br. bk. Charles S. Whitney	A. Montgomery.
Bleis	Thos. J. Farrell.	Br. s. c. Bussard	Warren F. Wiley.	Am. schr. Comet	Geo. D. Spicer.
Holstein	W. Spratley.	Buffalo	Thomas Kirby.	Edward R. Emerson	D. McLeod.
Monart	R. Leach.	Gallie	E. de Aldecoen.	Elin A. Warner	W. H. Aldrich.
<i>Lepid Line.</i>		Marengo	J. Viereck.	Ettie H. Lister	A. H. Child.
Br. s. c. Bavaria	E. Parry.	Miscellaneous.	N. Campbell.	Br. bk. Exile	H. Graves.
Bulgarian	T. H. Fox.	Am. s. c. Amicette	R. S. Thompson.	Am. schr. Florence Rogers	S. D. Mason.
Latin	M. Fitt.	Angerton	Coye Siders.	Flourine	Geo. J. Pearce.
Virginian	B. Risk.	Craighill	G. S. Murray.	Frattelli Laurin	J. A. Tilley.
<i>Mellory Line.</i>		Crabbrook	F. Hamelmann.	Heleas	Wm. Manson.
Br. s. c. Alamo	Jas. Daniels.	Edith Golden	Am. schr. Premier	Hugo	Lodovico Laurin.
Colorado	J. F. Lewis.	El Callao	Am. bk. Iodine	Rich'd Webster	T. K. Verbricht.
Rio Grande	A. C. Burrows.	Elstow	Ger. bk. Josephine	Am. bk. Leucadia	Adam Smith.
<i>Mediterranean &amp; New York S. S. Co.</i>		Emilia	Am. bk. L. & W. Armstrong	Br. bk. Mary	Charles Brown.
Br. s. c. Pontine	F. Blyth.	Flintroy	Am. bk. Nannie T. Bell	Am. schr. Nelson Bartlett	John Stohft.
<i>Min. &amp; Dominion S. S. Co.</i>		Glennfuegos	Ger. bk. Otto	Orion	H. F. Schvies.
Br. s. c. Montreal	R. Bouchette.	Hugo	Am. bk. Pillau	Premier	S. D. Mason.
Ontario	W. P. Couch.	John Nicholson	Dan. bk. River Gauger	Quos	Geo. J. Pearce.
Sardinia	Joseph Gibson.	Lozano D. Baker	Am. schr. Rollin Sanford	Millo	J. A. Tilley.
Toronto	Jas. McAuley.	Madrid	Ger. bk. Shakspeare	River Gauger	Wm. Manson.
<i>North Atlantic Line.</i>		Matthew Bedlington	Am. bk. Teneriffe	Am. bk. The Lord Warden	T. K. Verbricht.
Br. s. c. Assyrian Monarch	John Harrison.	Nayarro	Am. bk. Union	Water Witch	John Hughes.
Lylian Monarch	T. C. Huggett.	Palates			D. W. Storer.
<i>Roman Line.</i>		Saint Roman			Nath. Hocken.
Br. s. c. Euxine	R. B. Quick.	Sacrobosco			J. H. Welden.
<i>National Line.</i>		<i>New York Herald Weather Service.</i>			C. Gallus.
Br. s. c. America	Thos. Grace.	Am. s. c. Acadia			T. Moller.
Canada	R. S. Rigby.	Br. bk. Alaska			A. Montgomery.
Denmark	J. Sumner.	Am. bk. Aller			Geo. D. Spicer.
Egypt	G. Robinson.	Alps			D. McLeod.
Kirin	G. Cochran.	Alvora			W. H. Aldrich.
Holvetia	W. Tyson.	America			A. H. Child.
Holland	W. Pearce.				H. Graves.
Italy	J. Milligan.				S. D. Mason.
The Queen					Geo. J. Pearce.



# MONTHLY WEATHER REVIEW.

VOL. XIV.

WASHINGTON CITY, SEPTEMBER, 1886.

No. 9.

## INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during September, 1886, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and eighty vessels have been used.

Icebergs, in limited numbers, were reported in, and to the eastward of, the Strait of Belle Isle, at intervals during the month. To the eastward of Newfoundland isolated bergs were encountered as far south as Cape Race.

The atmospheric pressure for the month has been greatest over the eastern part of the country and least over the central and western portions. In the eastern sections it averaged about 0.5 above the normal; in the Mississippi Valley, and westward to the Pacific Ocean, it was normal or nearly so.

Over the eastern portion of the country and greater part of the Mississippi Valley the month has been about one degree warmer than the average September.

The precipitation was largely deficient in the Ohio Valley, east Gulf States, and all states bordering on the Atlantic Ocean, producing a drought which retarded the growth of newly sown wheat, but the clear weather was rather favorable to the cotton interests. In the western Gulf states and Rio Grande Valley it was very largely in excess of the normal, the total rainfall at Brownsville, Texas, being 30.57 inches, and at Galveston, Texas, 13.31 inches.

On chart i for this month are traced the paths of eleven areas of low pressure; the average number for September during the last fourteen years being 9.2.

The most severe storm of the month occurred over the west Gulf coast, the centre of which passed near Brownsville, Texas, on the night of the 22d, causing easterly, followed by westerly, gales at that place.

During September numerous earthquake shocks were felt throughout the Southern States, but all of them were light, doing no damage.

In this REVIEW will be found a table showing the dates of the first snows at all Signal Service stations east of the Rocky Mountains for each winter from the winter of 1873-'74 to that of 1885-'86, inclusive.

In the preparation of this REVIEW the following data, received up to October 20, 1886, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty Canadian stations, as telegraphed to this office; one hundred and sixty-four monthly

journals; one hundred and fifty-nine monthly means from the former, and twenty monthly means from the latter; two hundred and seventy-six monthly registers from voluntary observers; fifty-eight monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Georgia, Indiana, Illinois, Iowa, Minnesota, Missouri, Nebraska, New England, Ohio, and Tennessee; trustworthy newspaper extracts, and special reports.

## ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The distribution of mean pressure for September, 1886, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

An examination of the chart will show that the area of maximum pressure, enclosed by the isobar of 30.10, extends along the Atlantic coast from Eastport, Maine, to northern Georgia; the southern part of the area extends as far inland as Nashville, Tennessee; within this line the mean pressure for the month ranges from 30.10 to 30.13. To the westward of this isobar the pressure decreases until a minimum, bounded by an isobar of 29.80, is reached. This area of minimum pressure covers southeastern California, southern Nevada, and western Arizona. Two areas of low pressure, indicated by the isobar of 29.90, are also shown; one extends over northern Dakota and northeastern Montana; the other covers the extreme southern portion of Texas. The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The mean pressure for the month, when compared with the normal, shows very small departures; including the valley of the Mississippi, the upper lake region, and westward to the Pacific Ocean, the pressure is about normal, the greatest departures being only .03 above or below. Two exceptions to this statement are to be noted, viz., over a small area covering the northern part of Minnesota and Dakota the mean pressure for the month is .05 below the normal. At Tatoosh Island, Washington Territory, an excess of .07 occurs. In New England, the middle and south Atlantic states, the east Gulf states and Florida, an excess of .04 to .08 occurs. The lower lake region shows a departure of .02 to .04 in excess of the normal.

As compared with the mean pressure of the preceding month, August, 1886, an increase occurs in nearly all parts of the country, the only exceptions being a small area in northern Minnesota and Dakota, and the stations of Brownsville, Texas, Yuma, Arizona, and Fort Canby, Washington Territory, where the pressure for September coincides with, or is slightly below, that of August. In that portion of the United States lying to the eastward of the Mississippi River the increase varies from .10 in the east Gulf states, Tennessee, Ohio Valley, and the lower lake region to .15 in New England and the middle Atlantic states. Over the central and western sections the increase varies from .01 to .07, although in Idaho, Nevada, and the western portion of Washington Territory the increase averages .12.

## BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the table of miscellaneous data. The greatest ranges occur in New England and the Missouri Valley; the least in Florida, the Gulf States, and along the Pacific coast. Owing to the presence of a heavy storm at Brownsville, Texas, on the 20th, 21st, and 22d, the barometric range at that station, .91, is unusually large.

The following are some of the extreme monthly ranges:

Greatest.	Inch.	Least.	Inch.
Mount Washington, New Hampshire.....	1.18	New Orleans, Louisiana .....	0.20
Moorhead, Minnesota.....	1.04	Mobile, Alabama .....	0.23
Pike's Peak, Colorado.....	0.99	Pensacola, Florida .....	0.24
Saint Vincent, Minnesota.....	0.97	San Diego, California.....	0.24
Fort Totten, Dakota.....	0.97	Los Angeles, California.....	0.24
Eastport, Maine.....	0.95	Cedar Keys, Florida.....	0.25
Brownsville, Texas.....	0.91	Cape Mendocino, California.....	0.26
Huron, Dakota.....	0.91	San Francisco, California.....	0.27

## AREAS OF HIGH PRESSURE.

Nine well-defined areas of high pressure were observed during the month of September, seven of which first appeared in the northern Rocky Mountain region, or on the north Pacific coast. The month opened with a high area, extending over the eastern portion of the United States, central near the Lake region, and on the 15th of the month an area was observed north of the Saint Lawrence Valley. The general direction of movement was southeast over the mountain regions and thence eastward to the Mississippi Valley, while the direction was easterly, inclining slightly to the north, as the areas approached the Atlantic coast. The three areas of high pressure first observed on the Pacific coast moved southeastward and disappeared by a gradual decline of pressure over the eastern slope of the Rocky Mountains, while the four first observed in the northern Rocky Mountain regions passed eastward to the Atlantic, inclining first to the northeast and then to the southeast after passing the coast line, the latter movement being indicated by the stations on the immediate coast.

The average rate of movement for the high areas during the month was 27.7 miles per hour, the most rapid noted being forty miles and the slowest eighteen miles. By comparing these figures with tables showing movements of areas of low pressure it will be seen that the average, as well as the maximum and minimum, rates are very nearly the same.

I.—On the 1st of the month area number i covered the eastern portion of the United States, attended by clear weather, and in northern Michigan light frosts. It moved eastward over the Atlantic coast, the pressure increasing .30 at the centre as it passed over Nova Scotia on the 3d. The weather continued generally clear, or fair, over the regions named until the 8th of the month, although occasional showers were reported from Virginia southward to Florida. After this area passed to the east of Nova Scotia it apparently moved southward over the Atlantic, causing continued high pressure, with winds shifting to east and south in the eastern districts.

II.—This area was first observed on the north Pacific coast on the 5th, preceded by an extended low area over the southern plateau region. Killing frosts were reported in Nevada and Montana on the 5th, the area of high pressure extending eastward to the upper Missouri valley, where it was central on the morning of the 7th. The succeeding day it extended over the upper Mississippi valley and then disappeared, areas of low pressure being both to the northeast and northwest of the Lake region. There was no decided change in temperature attending this area of high pressure after it had passed eastward of the Rocky Mountains, although it was attended by a fall of from 20° to 30° in twenty-four hours over the middle and northern plateau regions.

III and IV.—This area (iii) was also first observed on the Pacific coast, the morning report of the 8th showing continued high pressure at the more northerly stations, while a storm of

considerable energy was central north of Dakota. The area continued almost stationary during the 9th, extending slowly southeastward over the mountain regions. During the 10th it moved southeastward to the central Mississippi valley, after which it could not be traced. It was followed, however, by a secondary area (number iv) of high pressure, extending over the northern Rocky Mountain region on the 11th, which produced killing frosts in northern Minnesota on the morning of the 12th. This secondary area was slight, but its movements were clearly traced first to the northeast, passing over the Mississippi Valley to eastern Tennessee on the 11th and 12th, and from Tennessee northward to Nova Scotia during the 13th and 14th. The fall in temperature was slight in the eastern portion of the United States, but general rains preceded this area during its advance over the Southern States.

V.—This area extended over the Saint Lawrence Valley on the morning of the 15th. It moved directly east, the barometer rising from 30.28 to 30.54 in twenty-four hours during its transit from the Saint Lawrence Valley to the longitude of Sydney, Nova Scotia, and disappeared rapidly on the 17th in advance of a severe storm in the Lake region.

VI and VII.—These were areas of high pressure of slight intensity which approached from the northern Rocky Mountain region and passed southeastward to the upper Mississippi valley and thence eastward over the Lake region to the New England coast, the latter causing light frosts from New England westward to Michigan on the 20th and 21st, and killing frost in northern Michigan on the latter date. After reaching the coast number vii apparently divided, and a secondary area formed over the Northern States, central in Tennessee on the morning of the 23d, and moved northward over the Atlantic coast districts on the 24th and 25th.

VIII.—This high area was first observed on the Pacific coast on the 26th, where it continued during the succeeding twenty-four hours and then moved southeastward over the Rocky Mountains, disappearing in Texas during the 29th. Killing frost occurred at Cheyenne, Wyoming, on the 27th, and generally throughout Colorado and western Kansas on the 28th, and in New Mexico on the 29th. Light frost generally occurred throughout the Northwest on the 29th.

IX.—This area approached from the region north of Montana during the 29th, causing killing frosts throughout Dakota on the morning of the 30th. At the close of the month this area extended over the upper Mississippi and Missouri valleys and thence southward to Texas, while the pressure was low over the region to the westward of the Rocky Mountains.

## AREAS OF LOW PRESSURE.

Eleven areas of low pressure have been traced from the tri-daily weather charts during the month of September. The tracks of the centres of these areas are given on chart i, from which it will be seen that no area of low pressure has been traced over the states bordering on the Atlantic, and generally over the entire area south of the Lake region, while in the Northwest will be observed the area of maximum disturbance. A number of these areas of low pressure were not clearly defined; some were trough-shaped; others were secondary depressions developing in the southern portions of elongated depressions after the principal area had moved northward beyond the limit of observations. An examination of the precipitation chart (number iii), in connection with the storm-track chart, will show that the region of drought is identical with that of the minimum atmospheric disturbance. Comparing the tracks of tropical storms which occurred during September and August, from the record of previous years, it will be seen that they have developed farther to the westward than usual, and that they have passed from the water over the land, losing energy rapidly and disappearing in the Mississippi Valley or on the eastern slope of the Rocky Mountains. The tracks of low areas exhibited on chart i are more northerly than usual, and the average rate of movement was 27.5 miles per hour.

The following table shows the latitude and longitude in which



each area was first and last observed, with the average rate of movement in miles per hour:

Areas of low pressure.	First observed.		Last observed.		Average velocity in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I.....	40 00	114 00	51 00	88 00	37.0
II.....	53 00	108 00	51 00	63 00	30.0
III.....	49 00	91 00	50 00	65 00	30.0
IV.....	52 00	109 00	52 00	95 00	20.0
V.....	40 00	101 00	50 00	67 00	34.0
VI.....	38 00	102 00	49 00	62 00	40.0
VII.....	23 00	96 00	42 00	90 00	16.0
VIII.....	48 00	111 00	47 00	83 00	16.0
IX.....	53 00	113 00	52 00	94 00	21.0
X.....	39 00	102 00	50 00	61 00	31.0
XI.....	54 00	98 00	45 00	77 00	28.0

\* Easterly movement.

I.—This low area was central over the middle plateau region on the afternoon of the 4th, while high areas covered the Atlantic coast and north Pacific coast districts. It moved northeastward during the 5th as a trough of low pressure extending from northeast to southwest and covering the eastern slope of the Rocky Mountains. It disappeared north of Lake Superior without producing any marked weather conditions east of the Mississippi, and only light rains occurred within the region of lowest pressure in the Northwest and mountain regions.

II and III.—This disturbance (ii) was at no time central within the region of observations; it passed eastward near the northern boundary of the United States between the 8th and 12th and was apparently drawn southward as it approached the Lake region, after which it passed northeastward over the Saint Lawrence Valley, where the pressure reached its minimum and the winds their maximum velocity, on the 11th. This low area (iii) extended to the westward as far as Manitoba on the 11th, and a secondary disturbance over Lake Superior, which moved east and northeast, following the course of the principal area and developing great energy in the Lake region, where strong westerly winds occurred on the 12th. General rains occurred on the Atlantic coast and in the Lake region as this disturbance passed eastward, and at midnight a secondary depression had developed on the New England coast, attended by heavy rains. The pressure continued to decrease over the Maritime Provinces until the morning of the 13th when the minimum pressure, 29.49, occurred at Bird Rock, Gulf of Saint Lawrence.

IV.—This disturbance was central south of Montana on the 14th; it passed southeastward, covering the northern slope of the Rocky Mountains, attended by high southerly winds from Kansas northward over Dakota and Minnesota; the barometer fell below 29.40 in western Minnesota at midnight of the 14th and there were indications that a severe storm would occur in the Lake region on the following day. The direction of movement changed to the northward on the 15th and the storm extended over Lake Superior, with moderate force. Previous to the northerly movement of this storm there was an area of relatively high pressure on the Atlantic coast and over the lower lake region, but during the eight hours between midnight of the 14th and the morning of the 15th the pressure increased rapidly in the Saint Lawrence Valley, and a well-defined, but contracted, high area was central in that region, slightly south of east of the storm-centre, on the morning of the 15th.

V.—This disturbance developed in the southern portion of the barometric trough which attended the preceding storm. The barometer was below 29.50 from the Missouri River westward over Colorado on the afternoon of the 15th. The region of low pressure extended from Texas northward to Manitoba, with a slow easterly movement during the 15th and 16th, the southern portion of the depression being somewhat retarded in its movement, causing the barometric trough to extend from the Indian Territory northeastward over the upper lake region,

while the region of lowest pressure was north of Lake Superior. The winds were strong from the south and the temperature was high to the east of this depression, while the winds were northerly to the west of it. These conditions resulted in the development of numerous tornadoes, the location of which are given on the tornado chart accompanying this REVIEW. Very heavy rains occurred throughout the states bordering on the great lakes, and strong winds occurred over Lake Huron. This storm, after contracting and moving northward of Lake Superior, passed directly eastward to the lower Saint Lawrence Valley, where it disappeared on the 18th, attended by westerly gales at the northeast stations. In this disturbance the barometer reached its minimum to the west of the Mississippi, and its maximum energy probably occurred in the southern portion of the upper lake region.

The following notes by Signal Service observers are of interest in connection with low areas number iv and v:

Moorhead, Minnesota: the barometer fell rapidly during the 14th, reaching 29.26 at 11 p. m. A southerly gale set in at 5.45 p. m. and continued until after midnight, maximum velocity, fifty miles per hour, at 10 p. m. Light rain, with thunder and lightning, began at 10.06 p. m. Gale ended at 1.06 a. m. of the 15th.

Saint Paul, Minnesota: at 11.41 p. m. of the 15th the wind suddenly increased in force and blew a gale from the west, attaining a maximum velocity of thirty-two miles per hour; the gale was accompanied by heavy rain, thunder, and lightning.

Port Huron, Michigan: thunder, lightning, and heavy rain began at 2.41 p. m. of the 16th and continued until 3.55 p. m. A gale from the southwest began at 2.38 p. m. and reached its greatest velocity, forty miles per hour, at 2.45 p. m.

Keokuk, Iowa: at 4.40 a. m. of the 16th a thunder-storm and light rain began; the storm moved from the southwest, and was preceded by southwest wind blowing at the rate of thirty-one miles an hour, and followed by east wind. Heavy rain began at 6.40 a. m. and continued, with short intermissions, until 3.25 p. m.

Greencastle, Indiana: a heavy thunder and rain storm passed over this place during the afternoon of the 16th. At 1.15 p. m. heavy rain, accompanied by a gale from the southwest, of twenty-eight miles per hour, set in.

Detroit, Michigan: heavy rain, with thunder, began at 2.30 p. m. of the 16th. Direction of the wind before the storm, west; after, southwest. During the storm the wind attained a velocity of twenty-seven miles per hour from the west. The rainfall in thirty minutes was 0.50 inch.

Saint Louis, Missouri: during the 16th heavy wind, veering from south to north, prevailed during the greater part of the day; at 9.40 a. m. it attained a velocity of forty miles per hour. Light rain began at 5.55 p. m. and continued, with short intermissions, until 10.15 p. m.

Lamar, Missouri: a severe thunder-storm, with light and heavy rain, occurred between 3.10 and 5.05 p. m. of the 16th. For fifteen minutes after 3.40 p. m. light hail fell. During the storm high southwest wind prevailed; maximum velocity, twenty-eight miles per hour; direction of wind before the storm, southwest; after, north.

Buffalo, New York: on the 16th a thunder-storm passed over the city from west to east. The storm began at 7.20 p. m. and was accompanied by fresh to brisk wind. At 10.10 a. m. of the 17th the wind reached a velocity of thirty miles per hour from the southwest.

Erie, Pennsylvania: a severe thunder-storm, accompanied by heavy rain, began at 6.05 p. m. of the 16th; the storm moved from the west toward the east. From 6.30 to 6.40 p. m. the wind blew with the velocity of a gale, blowing down piles of lumber and uprooting a few trees.

See "Local storms and tornadoes" for further notes relative to this low area.

VI.—This disturbance was central in Colorado on the morning of the 18th, and the afternoon report of that date showed a narrow barometric trough, extending from Missouri westward over Colorado, moving rapidly to the northeast with increasing energy during the time that the centre was within the limits of observations. The strongest gales occurred at the northeastern Canadian stations on the 20th, and the barometer fell to 29.21 at Bird Rock, Gulf of Saint Lawrence, at midnight of the 20th, when the centre of disturbance was near that station. This area of depression was extended, and it possessed but slight energy while passing eastward to the Lake region; it became contracted while passing over the Saint Lawrence Valley but again extended after reaching the Atlantic.

VII.—This is the only tropical storm that occurred during the month; the track is approximately traced northward along the west Gulf coast near the mouth of the Rio

Grande River. The records from Brownsville, Texas, show that easterly gales occurred during the night of the 22d, the barometer reaching a minimum of 29.15, and the wind a velocity of fifty miles from the northeast at the 11 p. m. report. The winds shifted to west through north, and a velocity of thirty-six miles, west, was reported at the 7 a. m. report of the 23d. The rainfall which occurred at Brownsville, Texas, during the prevalence of this storm from the 20th to 23d, amounted to 25.98 inches. The barometer rose rapidly as this storm moved over the land, and it was difficult to locate the centre of disturbance after it had reached the interior of Texas.

The following notes from Signal Service observers indicate the severity of this storm during its presence in Texas:

Galveston, Texas: light and heavy rain fell during the greater part of the 21st and 22d. At 1.20 p. m. of the 22d an easterly gale of twenty-seven miles per hour set in; heavy rain and gale continued throughout the night. Light rain fell during the 23d; at 11.35 p. m. a southerly gale set in and continued until 9.40 a. m. of the 24th; maximum velocity thirty-four miles per hour. At Corpus Christi the storm was more severe than at Galveston; at 3 p. m. of the 24th the gale attained a velocity of sixty-eight miles per hour from the northeast, and was accompanied by very heavy rain. The tide was very high, overflowing the lower portion of the town and carrying away thousands of ties from the Mexican-National and Aransas Pass railways.

Brownsville, Texas: on the 21st heavy rain set in at 12.18 a. m. and continued, with short intervals of light rain, all day; total rainfall in twenty-four hours 10.32 inches. During the night of the 21st-22d high easterly winds prevailed, attaining at 10 p. m. a velocity of twenty-four miles per hour. Light and heavy rain continued during the 22d; total amount for twenty-four hours 11.91 inches. Fresh and high easterly winds prevailed during the day. At 1.30 p. m. the barometer began falling rapidly, reading 29.54 inches at 3 p. m. and 29.15 inches at 11 p. m. During the afternoon the wind increased in force, attaining at 9.30 p. m. a velocity of sixty-eight miles per hour from the east. The easterly gale continued until 12.30 a. m. of the 23d, when the wind lulled and the barometer began to rise. At 2 a. m. the wind veered to west and began blowing hard, attaining between 3 and 9.45 a. m. the force of a gale; maximum velocity thirty-nine miles. The heavy rain ended at 7.48 a. m., but the sky remained overcast until 4.53 p. m., when it began to clear. The gale did considerable damage by blowing down trees, fences, and telegraph poles; much property was also destroyed by flood. During the four days that this storm prevailed, 20th, 21st, 22d, and 23d, 25.98 inches of rain fell.

VIII.—When the preceding storm was moving northward along the west Gulf coast an extended area of low pressure was observed in the northern Rocky Mountain region. This disturbance moved slowly eastward extending southward to northern Texas, the barometer falling to 29.40 in northern Dakota on the afternoon of the 23d. The approximate track of the centre of this area is given on chart i, from which it will be seen that its movements were irregular and that it was attended by secondary disturbances. When the Gulf storm was central in northern Indian Territory number viii extended over the upper lake region, attended by strong southwesterly winds. The area of high pressure which covered the Atlantic coast during the 25th gave way rapidly on the approach of this storm, which disappeared to the northeast on the 26th, causing strong southwest winds on the New England coast.

IX.—This area probably developed in the north Pacific; it was observed as central in Montana on the morning of the 25th, and moved over the eastern slope of the Rocky Mountains north of the territories, disappearing to the northward before reaching Lake Superior, but leaving a barometric trough which extended southwestward to New Mexico, and within which the following-described low area developed:

X.—This area was central in eastern Colorado on the 26th, while low areas were central in the Saint Lawrence Valley and north of Manitoba, and high areas covered the south Atlantic and north Pacific coasts. This disturbance passed northeastward over the Lake region, attended by rains in the Northern States, but the barometer remained about stationary at the centre during the transit, and only light to fresh winds were reported in the Lake region.

The following notes relative to low areas number ix and x have been received from observers:

Fort Buford, Dakota: on the 26th a westerly gale set in at 1.45 a. m. and continued until 3 a. m.; maximum velocity thirty-eight miles per hour; light

rain fell from 6.30 to 8 a. m. The wind continued high and from the west all day; between 7 and 8.30 a. m. it blew at the rate of forty-five miles per hour. Fair weather and high westerly winds prevailed during the 27th; maximum velocity forty-eight miles per hour at noon.

Moorhead, Minnesota: on the 26th, at 9.35 a. m., a gale began to blow from the southeast; maximum velocity thirty-seven miles per hour at 12.45 p. m.

Saint Vincent, Minnesota: on the 26th, at 11.10 a. m., a gale set in, attaining at 1.15 p. m. a velocity of thirty-two miles per hour from the south. At 8.15 p. m. the wind became high again; maximum velocity twenty-eight miles per hour from the west.

XI.—This area appeared far to the north of Manitoba on the 29th and passed southeastward, developing great energy over the northern portion of the upper lake region during the night of that date, the barometer falling to 29.29 at Prince Arthur's Landing at the midnight report. At the close of the month this storm was central near Kingston, Ontario, with brisk to high westerly winds over Lakes Huron and Erie. The pressure had increased .30 near the centre of disturbance during its passage from Lake Superior to the Saint Lawrence Valley.

The following notes relate to this storm:

Moorhead, Minnesota: on the 29th high northwest wind prevailed from 3.40 to 8 p. m.; maximum velocity thirty miles per hour, at 6.02 p. m. Light rain fell from 4.15 to 7.45 p. m.

Escanaba, Michigan: after 3 p. m. of the 29th the barometer began to fall very rapidly, at the same time increasing southwest wind set in, reaching at 10 p. m. a velocity of twenty-six miles per hour.

Saint Vincent, Minnesota: at 12.35 p. m. of the 29th light rain began and continued until 2.43 p. m., the rain was followed by a northwest gale from 2.30 until 8.45 p. m., with a maximum velocity of thirty-nine miles per hour. Light snow fell from 9 to 10.50 p. m.; depth, one inch.

Duluth, Minnesota: during the 29th the sky was overcast, heavy rain fell from 8.15 to 9.40 p. m. Wind southwest and increasing in velocity throughout the day, at 10.35 p. m. it veered to northwest and reached a velocity of thirty miles per hour.

Sandusky, Ohio: at 12.15 p. m. of the 30th a gale set in from the southwest; at 6 p. m. the wind veered from southwest to northwest and increased in force, maximum velocity forty-six miles per hour; the gale continued during the night. Heavy rain fell from 6.30 to 9 p. m. The cautionary signals which had been hoisted twelve hours previous to the storm, 12.45 a. m., gave all persons interested ample time to prepare for its coming.

#### NORTH ATLANTIC STORMS DURING SEPTEMBER, 1886.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to October 20, 1886.

Ten depressions are traced, of which six passed eastward over the Gulf of Saint Lawrence and Newfoundland; three are charted across the ocean from coast to coast; two originated to the westward of the British Isles; one first appeared southeast of Greenland, and one apparently developed over mid-ocean between the fortieth and forty-fifth parallels. Violent cyclonic disturbances were reported in the sub-tropical regions north of the West India Islands during the second and third decades of the month, but reports at hand will not admit of accurately locating the centres and tracing the tracks. It is not thought that these storms were of a general character.

The following presents the characteristics of the depressions traced for the present month, as compared with those traced over the north Atlantic for September, 1885:

In September, 1885, twelve storm-areas appeared, of which two were continuations of storms which first traversed the North American continent; one was a hurricane which originated and disappeared within the tropics, and one a somewhat severe storm which developed suddenly near the mouth of the English Channel. The weather over the north Atlantic was



generally stormy and unsettled, especially over the region east of the fortieth meridian, with frequent marked fluctuations of the barometer, and moderate to strong gales, mostly from nw. to sw.

In September, 1886, the weather was unsettled over the British Isles and the ocean to the westward during the first half of the month. Advices from Glasgow, under date of the 6th, state that the heaviest rain storm ever known in that part of Scotland occurred there and over the western portion of the country; it did much damage to the crops. The depressions traced were rather evenly distributed during the month, and with but one exception the tracks are located north of the forty-seventh parallel. While the depressions, in general, exhibited less energy than those traced and described for the preceding month (August 1886), and the destructive features accompanying their passage were not so marked, each decade embraced storms of considerable violence along, or in the vicinity of, the trans-Atlantic tracks. Numbers 3, 4, 5, 7, 8, and 9 were characterized by very low barometric pressure, and accompanied throughout by hard gales and generally rough weather. Irregular reports are at hand relative to violent disturbances encountered south of the region through which depressions are traced, but as these reports are neither sufficient in number nor, in cases, accurate in detail, the paths of the centres of cyclonic areas within which the storms were encountered cannot be charted.

The following are brief descriptions of the depressions traced:

1.—This storm passed northeast over Newfoundland during the 1st, with central pressure about 29.70 (754.4), and fresh to strong gales and rain-areas southward to the thirty-fifth parallel. By the 2d the depression had passed northeast beyond the region of observation.

The following special reports are from vessels which were located in the southern quadrants of the depression:

The s. s. "Columbia," Capt. T. Mitchell, commanding, on the 1st, in N. 41° 10', W. 63° 50', had a strong gale, force 9, from sw. veering to nw. and n.; lowest barometer, 29.80 (756.9), at noon. The bark "Hiram Emery," Capt. F. W. Gorham, commanding, on the 1st, in N. 37° 11', W. 69° 36' (at noon), had a strong gale beginning at 3 a. m. from the sw., which continued, with very high seas and heavy rain, until 1 a. m. of the 2d, then veered to nw. and moderated. The rain was so heavy that the water was ankle deep on the deck at times.

2.—This storm first appeared on the 4th, in N. 60°, W. 23°, and was, possibly, a continuation of number 1, although an absence of reports will not admit of establishing the fact. On the 4th central pressure about 29.50 (749.3) was shown. During this date the depression moved southeast to N. 56°, W. 15° by the 5th, with slightly higher pressure; thence passing northeast to the north of Scotland during the 6th, with areas of heavy rain and fresh to strong s. and sw. gales to the forty-sixth parallel. The storm-centre passed eastward beyond the region of observation during the 6th without apparent loss of energy.

The following special reports were made relative to storms encountered during the passage of this depression:

The bark "Sarah," Captain Atkins, commanding, on the 4th, in N. 59° 0', W. 19° 48' (at noon), had a fresh gale from ssw. in early a. m., moderating in p. m.; barometer 29.58 (751.3) at noon. Chief Officer Kinning, of the s. s. "Roman," Capt. D. Williams, commanding, reports: "6th, in N. 51° 8', W. 14° 20' (at noon); 4 a. m. strong wind from sw., heavy sea and rain; 6 a. m. wind veered to nw. and increased to fresh gale, and at 8 p. m. to strong gale; 2 p. m. wind moderated to strong breeze, and at 10 p. m. backed to sw., then veered to w., and increased at midnight to fresh gale; barometer 29.84 (757.9) at noon."

3.—This storm followed closely after the one last described, and on the 7th, when central in about N. 58°, W. 17°, exhibited central pressure below 29.20 (741.7), and occasioned strong gales over an area extending to latitude 45° N., longi-

tude 40° W. On the 8th the centre of depression was located northwest of Scotland, with slight changes in central pressure, whence it passed east beyond the limit of observation without apparent loss of energy.

The following special reports were made relative to this storm:

The s. s. "Roman," on the 7th, in N. 50° 35', W. 19° 46' (at noon), had a strong gale, w., with heavy showers of rain and high seas; at 10 a. m. wind backed to sw. and continued with heavy squalls, then veered to w. and nw.; barometer 29.74 (755.4) at noon; continued strong gale all day; 8th, in N. 50° 3', W. 23° 30' (at noon), very heavy seas and squally; wind backed to sw. at 3 p. m. and calmed down.

Chief Officer Evans, of the s. s. "Scaw Fell," Capt. J. Stanhope, commanding, reports: "7th, in N. 50° 15', W. 12° 11' (at noon), strong gale began at 8 a. m. from s., with high seas; continued all day; wind veering to w. in a. m. of the 8th in N. 50° 23', W. 15° 23' (at noon); 2 a. m. very strong gale, w., with showers of rain and high seas; 8 a. m., wind veered to wnw., and continued all day, backing to sw. at 1 a. m. of the 9th, in N. 50° 22', W. 18° 11' (at noon); 3 a. m., veered to nw., and moderated at 8 p. m." The s. s. "Assyrian Monarch," on the 7th, in N. 50° 30', W. 15° 36' (at noon), had a heavy gale from the w., with violent squalls; barometer fell to 29.10 (739.1) at midnight. Chief Officer Simpson, of the s. s. "Gallia," Capt. M. Murphy, commanding, reports: "8th, a moderate gale began at 8 a. m. from sw., while off Queenstown; veered to w. in p. m., with squalls, and continued increasing at 4 a. m. on 9th, in N. 51° 24', W. 15° 42' (at noon), to brisk gale sw., with heavy sea; backed to s., then veered to w. and nw., and moderated in p. m.; lowest barometer, 29.40 (746.7), at 4 a. m. of the 9th."

Capt. B. Gleadell, commanding the s. s. "Celtic," reports: "6th, fresh gale commenced from wnw., and continued until the p. m. of the 7th; lowest barometer, 29.81 (757.2), at 10.30 a. m. of the 7th, in N. 49° 11', W. 36° 04'. The winds preceding the disturbance were from northeastward, and the winds following were mostly from s., sw., and wnw., being moderate to strong breezes, with squalls." The s. s. "Normandie," Capt. G. de Kersabeie, commanding, on the 6th and 7th, had a whole gale from w., veered to nw.; lowest barometer, 29.37 (746.0), at 10 a. m. of the 7th, in N. 50° 50', W. 28° 10'. The s. s. "Wisconsin," Capt. E. Bentley, commanding, on the 6th, in N. 48° 38', W. 42° 37', had a hard gale from nw.; barometer 29.60 (751.8) at noon.

Chief Officer W. Thompson, of the s. s. "Stockholm City," Capt. K. Doyle, commanding, reports: "8th, in N. 49° 51', W. 13° 15' (at noon), at 5 a. m. a moderate gale began from w.; subsided at 4 p. m. to strong breeze, and increased at night to moderate gale, w., and increased on the 9th, in N. 50° 3', W. 16° 35' (at noon), to brisk gale, backing to sw. at 1 a. m.; 4 p. m., veered to nw., with heavy squalls and high seas, and then moderated; barometer 29.59 (751.6) at noon, then rising." The s. s. "Galileo," Capt. R. Potter, commanding, on the 9th, in N. 49° 20', W. 17° 33' (at noon), had a whole gale from midnight to 4 a. m.; wind ssw., with lightning, heavy rain, and high sea; wind veered to westward at 4 a. m.; lowest barometer 29.27 (743.4). The s. s. "Ethiopia," Captain Wilson, commanding, on the 9th, while lying at Greenock, Scotland, had a fresh gale from se., veering to westerly; lowest barometer, 29.23 (742.4), at noon.

The s. s. "Manitoba," Capt. R. Caruthers, commanding, left Moville on the 9th, with wind blowing a fresh gale from ssw. at 8 a. m.; veered to w. at night, and moderated at midnight; lowest barometer, 29.32 (744.7), from noon to 4 p. m. Capt. R. S. Thompson, commanding the s. s. "Sacabosco," reports: "8th, 2 a. m., in N. 49° 30', W. 24° 20', blowing hard gale from w., with high sea; barometer 29.60 (751.8) at 5 p. m.; wind gradually abated and backed to sse., with torrents of rain; barometer falling; 9th, 2 a. m., barometer 29.25 (742.9); wind blowing with hurricane force, and gradually hauling point by point with the sun to the nw.; shortly after

which the weather moderated; lowest barometer, 29.15 (740.4), at 3 a. m., in N. 50°, W. 19°." This vessel encountered the disturbed conditions which prevailed in the southwest quadrant of depression number 3 and along the extreme southeast edge of depression number 5.

4.—This depression was central on the 8th in the Gulf of Saint Lawrence and passed north of east over the northern portion of Newfoundland to N. 51°, W. 52° by the morning of the 9th, with pressure ranging below 29.20 (741.7), and moderate gales. Pursuing a generally easterly course the storm-centre passed south of Ireland during the 13th. In its eastward passage this depression had slight pressure changes and strong gales during the 9th, 10th, and 11th; during the 12th there was a slight rise in central pressure and moderate gales to the southeastward; on the 13th it had commenced to fill up and possessed small energy. Special reports submitted relative to this storm show that while generally stormy weather attended its path remarkable or unusual features were not noted.

5.—This storm apparently developed over mid-ocean in about latitude N. 55° on the 8th, but its centre was not well-defined until the 9th, when it was located in N. 58°, W. 34°; from this position it passed eastward, with pressure 29.10 (739.1) to 29.20 (741.7), and fresh to whole gales, disappearing north of Scotland during the 11th.

The following special reports are at hand relative to this storm:

The s. s. "Toronto," Capt. J. McAuley, commanding, on the 8th, had a moderate gale from nnw. to w.; lowest barometer, 29.43 (747.5), at noon, in N. 55° 30', W. 38° 10'. The s. s. "Scaw Fell," on the 10th, in N. 50° 12', W. 23° 1' (at noon), had a fresh gale, nw., beginning at 4 a. m.; 10 a. m., backed to sw. and increased to strong gale, with heavy showers of sleet and high seas; 11 a. m., whole gale, sw.; 2 p. m., veered to w., and to nw. at 10 p. m., moderating at midnight.

The s. s. "Gallia," on the 10th, in N. 50° 51', W. 24° 04' (at noon), had a fresh gale from sw., beginning at 10 a. m., with rain squalls and head seas; veered to w. and nw. in p. m., and moderated at midnight; lowest barometer, 29.43 (747.5), at 4 p. m., then rose rapidly. The s. s. "Stockholm City," on the 10th, in N. 49° 47', W. 21° 22' (at noon), had a moderate gale from sw., beginning at noon; 4 p. m., increased to brisk gale, sw. by w., then veered to w., and moderated; lowest barometer, 29.59 (751.6), at 4 p. m. The s. s. "State of Georgia," Capt. G. Moodie, commanding, on the 10th, had a fresh gale from se., backing to e. and ene., then veering to sw., w., and nw., and backing to ssw.; lowest barometer, 28.95 (735.3), at 10 p. m., in N. 55° 3', W. 18° 23'. The s. s. "Manitoban," on the 11th, in N. 55° 21', W. 17° 53' (at noon), had a fresh gale, beginning at 4 a. m. from sw., with heavy seas; 6 a. m., veered to nw., and moderated to strong breeze at 8 a. m.; barometer read 29.02 (737.1) at 4 a. m., and 29.50 (749.3) at midnight.

The s. s. "Buenos Ayrean," Capt. J. Scott, commanding, on the 11th, had a fresh gale, sw., with squalls; lowest barometer, 29.45 (748.0), at noon, when in N. 55° 23', W. 8° 8'. Chief Officer Stembridge, of the s. s. "Norseman," Capt. E. Maddox, commanding, reports: "Left Liverpool on the 11th, with fresh gale blowing from ssw., which continued till 4 a. m. of the 12th (in N. 51° 54', W. 7° 54', at noon), veering to sw., and moderating." The s. s. "Istrian," Capt. T. H. Fox, commanding, left Liverpool on the 11th, with a fresh gale from sw., which subsided to moderate gale, sw., by a. m. of the 12th (in N. 51° 48', W. 6° 30', at noon), with heavy sea; barometer 29.88 (758.9) at noon of the 12th.

6.—This depression was central on the morning of the 11th near the mouth of the Saint Lawrence River, with pressure below 29.60 (751.8); passing over Newfoundland it apparently dissipated to the eastward during the 12th.

7.—This storm passed eastward over Newfoundland during the early morning of the 14th, but was unimportant until the 16th, when it developed strong force, with pressure about 29.70

(754.4). On the 17th the depression was central in N. 52°, W. 29°, with pressure about 29.50 (749.3), and strong to whole gales in the southwest quadrant; from the 18th to 20th, inclusive, the storm-area remained nearly stationary over mid-ocean in latitude 50° N., with pressure about 29.40 (746.7), and hard gales; from this position it moved slightly south of east and disappeared in the direction of the French coast during the 22d, without apparent loss of energy.

The following special reports have been received from vessels encountering storms within the area of this depression:

The s. s. "Wisconsin," Capt. E. Bentley, commanding, on the 16th and 17th had a whole gale from ssw., veering to nw.; lowest barometer, 29.58 (751.3), at 11 p. m. of the 16th, in N. 47° 36', W. 40° 30'. On the 16th, at 8 p. m., there was a heavy confused swell from sw. and ne.; ship labored heavily. On the 17th, at 4.40 a. m., shipped a heavy sea, damaging the funnel and bridge. The schooner "Passby," on the 16th, in N. 50°, W. 42° 30', during a heavy nnw. gale, was struck by a heavy sea which caused much damage to the vessel and cargo. The s. s. "Rhyndland," Captain Jamison, commanding, on the 16th, had a strong gale from ssw. to nw.; lowest barometer, 29.58 (751.3), at midnight, in N. 49°, W. 37° 30'. The s. s. "Norseman," on the 16th, in N. 50° 6', W. 37° 19' (at noon), had a moderate gale from wnw. commencing at midnight, with heavy squalls and high seas; barometer at noon, 29.77 (756.1); wind increased to fresh gale, with heavy squalls and rain in a. m. of the 17th, in N. 49° 0', W. 41° 35' (at noon); veered to nw. in p. m. and continued until 4 a. m. of the 18th, in N. 48° 16', W. 47° 1' (at noon).

The s. s. "Istrian," on the 16th, in N. 50° 4', W. 33° 45' (at noon), had a fresh gale from nw., beginning at midnight and increasing to strong gale, nw., with high seas and squalls; 17th, gale continued all day; barometer 29.70 (754.4) at 9.30 a. m.; 18th, in N. 47° 17', W. 42° 40' (at noon), strong gale continued from nw., with high seas and heavy squalls until noon, then moderated. The s. s. "Waesland," Capt. J. Uberweg, commanding, had a strong gale from nnw. to w. on the 17th and 18th; lowest barometer, 29.60 (751.8), at 2 p. m. of the 18th, in N. 48° 30', W. 32° 18'. The s. s. "Schiedam," Capt. A. Potjer, commanding, on the 18th and 19th had a strong gale from sw. to wnw.; lowest barometer, 29.50 (749.3), at 4.30 a. m. of the 18th, in N. 48° 20', W. 34° 50'. The s. s. "Buenos Ayrean," Capt. J. Scott, commanding, had a strong gale from w. to n., with heavy squalls, on the 16th and 17th; lowest barometer, 29.70 (754.4), at noon of the 16th, in N. 53° 0', W. 48° 6'.

The s. s. "Warwick," Capt. W. Janes, commanding, on the 18th, in N. 48° 35', W. 35° 2' (at noon), had very high sea and violent squalls accompanied by heavy rain and hail; barometer 29.62 (752.3). The s. s. "Donan," on the 20th, in N. 49°, W. 30°, had a moderate gale from nnw., moderating at daylight of the 21st. Chief Officer Walker, of the s. s. "British Queen," Capt. R. Wills, commanding, reports: "21st, in N. 49° 32', W. 31° 12' (at noon), moderate gale from nw. commenced at 4 a. m., with squalls; moderated in p. m. and backed to sw.; barometer 29.65 (753.1) at 4 a. m."

Chief Officer Galbraith, of the s. s. "Durham City," Capt. M. P. Lund, commanding, reports: "20th, in N. 50° 7', W. 30° 14' (at noon), at 4 p. m. fresh gale from nw., and heavy sea; 8 p. m., strong gale nw.; barometer at noon 29.47 (748.5); gale continued on 21st, in N. 49° 58', W. 35° 32' (at noon), backing at noon to w. and sw., then moderating to strong breeze, se., with heavy squalls; barometer at 8 p. m. 29.73 (755.1)." The s. s. "Waesland" had a strong gale from the 20th to 22d, from e. backing to n. and veering to nne.; lowest barometer, 29.59 (751.6), at 3 a. m. of the 21st, in N. 49° 50', W. 15° 45'.

8.—This depression passed northeastward over the northern portion of Newfoundland during the night of the 20th to N. 52°, W. 50° by the morning of the 21st, during which dates it exhibited central pressure about 29.40 (746.7), and caused strong gales to the southward; from the 22d to 24th, inclusive,



it merged into an area of low pressure central in about N. 55°, W. 45°, and dominated the weather conditions over nearly the entire ocean north of the fortieth parallel; it then circled eastward and disappeared north of Scotland during the 27th, being attended throughout its course by strong gales and generally rough weather.

The following special reports have been received relative to this storm:

The s. s. "Stockholm City," on the 20th, in N. 42° 53', W. 68° 31' (at noon), had a brisk gale, nw., beginning at 1 a. m.; wind backed to wsw. at 4 a. m., with furious squalls and heavy rain; 8 a. m., veered to nw. and continued with hard nw. squalls at 6 p. m., and moderated at midnight; barometer at 4 a. m. 29.91 (759.7). The s. s. "Istrian," on the 20th, in N. 42° 49', W. 52° 15' (at noon), had a strong gale from sw. beginning at 4 p. m., with heavy rain, moderating to fresh gale, sw., in a. m. of 21st, in N. 42° 33', W. 57° 4' (at noon), then veered to nw. and moderated; lowest barometer, 29.74 (755.4), at 8.20 a. m. of the 21st. The s. s. "Norseman," on the 20th, in N. 45° 13', W. 58° 32' (at noon), had a moderate gale from sse., beginning at 9.20 a. m., with heavy rain squalls; veered to wsw., w., and wnw., and moderated at 4 a. m. of 21st, in N. 43° 44', W. 62° 21' (at noon).

The s. s. "America," on the 21st, from N. 44° 29', W. 55° 13' to N. 43° 48', W. 57° 42', had a strong gale from wnw., with heavy sea. The s. s. "Nova Scotian," Capt. R. H. Hughes, commanding, had a fresh gale from s. to wsw., from the 19th to 22d; lowest barometer, 29.38 (746.2), at 5.15 p. m. of the 21st, in N. 49° 4', W. 48° 40'. The s. s. "Austrian," Capt. J. Ambury, commanding, had a moderate gale from ssw. to nw. on the 21st; lowest barometer, 29.62 (752.3), at 11 p. m., in N. 48° 45', W. 41° 0'.

Chief Officer C. von Qualen, of the s. s. "Island," Capt. W. Skjodt, commanding, reports: "On the 21st, in N. 52° 40', W. 33° 19' (at noon), had a whole gale, beginning at 8 p. m.; wind set in from the se. and shifted to s.; rain, with heavy increasing sea, from sw. and w. 22d, in N. 50° 30', W. 38° 8' (at noon), at 4 a. m. wind changed suddenly to w., with rising barometer and clearing weather; wind continued blowing hard, with a heavy sea; from 10 p. m. to midnight wind changed to s., with very heavy rain, then changed to sw. 23d, blowing hard all day from w., with heavy squalls and very rough sea."

The s. s. "Hermann," Capt. A. Kohlmann, commanding, on the 20th, in N. 50° 11', W. 33° 1' (at noon), at midnight, barometer 29.73 (755.1); southerly gale. 21st, 2 a. m., barometer 29.64 (752.8); wind shifted to nw. in a strong gale, with heavy sea from nw.; barometer then commenced to rise slowly, with a whole gale from wnw.; gale continued until the 23d, in N. 48° 59', W. 43° 41' (at noon). The s. s. "Donan," on the 22d, had a strong gale from w. during the early a. m.; position at noon, N. 47° 16', W. 41° 53'. The s. s. "City of Richmond," Captain Redford, commanding, on the 22d, in N. 44° 45', W. 54° 45', had a gale, force 7 to 8, from wnw.; lowest barometer, 29.78 (756.4), at 6 a. m.

Capt. B. Woolfenden, commanding the s. s. "Pavonia," reports, "21st, strong breeze began in early a. m. from sw., with squally weather and high sea; 4 a. m., lightning in nw.; 7 a. m., wind veered to wnw., and at 1 p. m. increased to fresh gale. 22d, veered to nw. in a. m., with hard squalls, high seas, and heavy rains; 4 a. m., backed to sw.; veered to w. at 8 a. m., and at noon to nw., then moderated; lowest barometer, 29.65 (753.1), at 8 a. m. of 21st, in N. 44° 28', W. 52° 23'." The s. s. "British Queen," on the 22d, in N. 48° 50', W. 37° 8' (at noon), had a fresh gale from wsw. at 10 p. m., with heavy sea; wind veered to nw. in a. m. of the 23d, in N. 48° 2', W. 37° 10' (at noon), then backed to w. and increased at noon to fresh gale, w., with heavy sea, and moderated at midnight.

The s. s. "Durham City," on the 22d, in N. 49° 27', W. 40° 11' (at noon), had wind increasing to heavy gale, sse.; 12.30 a. m., suddenly shifted to w., and increased to very heavy gale with high sea; 8 p. m. backed to sw., blowing a terrific gale; 10 p. m., veered to w. 23d, in N. 48° 30', W. 42° 6' (at noon);

1 a. m., heavy gale, w., continuing all day, with very high sea, moderating in a. m. of 24th. Chief Officer Potts, of the s. s. "Palestine," Capt. W. Whiteway, commanding, reports: "23d, in N. 50° 32', W. 33° 44' (at noon), a moderate gale began at midnight from wsw., with squalls and high seas, and continued on the 24th, in N. 49° 51', W. 37° 27' (at noon), with rain squalls; veered to w. at noon, and moderated at 8 p. m."

Chief Officer Davies, of the s. s. "Virginian," Capt. M. Pitt, commanding, reports: "23d, in N. 48° 0', W. 35° 43' (at noon), a moderate gale began from sw. at noon, with rain; veered to w. and nw., and moderated at night." The s. s. "Adriatic," Capt. H. Parsell, commanding, on the 26th, in N. 51° 0', W. 20° to 25°, had a heavy gale from sw. veering to nw., with very high sea; lowest barometer, 29.25 (742.9), at 10 a. m.; at 2 30 p. m., the wind veered to nw., with decreasing force and clearing weather. The s. s. "British Princess," Capt. E. H. Freeth, commanding, on the 25th, in N. 51° 22', W. 24° 17', had wind south, with falling barometer; 26th, in N. 51° 16', W. 26° 39', had a gale of force 11, wind ssw.; barometer 29.10 (739.1); wind shifted slowly to nw. and moderated, and barometer began to rise; sea very heavy from sw.

The s. s. "Devonia," Capt. H. Young, commanding, on the 26th, had a whole gale from sse. to nw.; lowest barometer at 2 p. m., in N. 54° 27', W. 22° 5'. The s. s. "Hibernian," Capt. John Brown, commanding, on the 26th, had a strong gale from se. to wsw.; lowest barometer, 29.12 (739.6), at 4 p. m., in N. 54° 56', W. 15° 6'. Chief Officer Barwise, of the s. s. "Iowa," Capt. S. Walters, commanding, reports: "26th, 8 p. m., moderate gale began from sw., increasing at midnight to fresh gale, sw., with high sea and thick weather; 27th, 1 a. m., in N. 51° 29', W. 13° 9' (at noon), gale veered to w., and at 3 a. m. to nw., and moderated in p. m.; lowest barometer, 29.78 (756.4), at 4 a. m. of 27th."

The s. s. "State of Nebraska," Capt. A. G. Braes, commanding, on the 26th and 27th, had a whole gale from s., veering to wnw.; lowest barometer, 29.40 (746.7), at midnight of the 26th, in N. 55° 26', W. 10° 26'. The s. s. "Bulgarian," on the 27th, in N. 51° 40', W. 7° 41' (at noon), had a moderate gale, wsw., beginning at 4 a. m.; veered to w. and moderated at noon.

Capt. F. Bouchette, commanding the s. s. "Montreal," reports: "26th, in N. 55° 43', W. 14° 45' (at noon), in the afternoon wind backed to sw. and sse., with rough confused sea, barometer falling one and one-half tenths inches per hour; 4 p. m., barometer 29.14 (740.1), a whole gale with mist and rain; 6 p. m., wind began to veer to westerly; sea high and confused; midnight, wind wsw., barometer rising slowly, and wind moderating slightly.

9.—The development of this depression, in about N. 43°, W. 43°, was indicated by reports of the 24th; by the 25th the centre of the depression was clearly defined slightly to the northwest of this position, with pressure about 29.50 (749.3) and fresh to whole gales within an extended area to the westward. The depression moved southeast during the next two days and then circled northeastward, passing towards the north coast of Scotland during the 30th. This depression was accompanied by severe disturbances throughout its course, the general character of which may be determined by the following special reports of shipmasters:

The s. s. "Virginian," on the 25th, in N. 44° 27', W. 46° 20', had a strong gale from e. at noon, backing to ne., with rain and rising sea; increased at 8 p. m., with heavy sea, and moderated at 10 p. m. The ship "New City," on the 26th, in N. 44° W. 39°, had a hurricane from wsw., lasting seven hours. The ship "Alice D. Cooper," on the 28th, in N. 45° 13', W. 36° 5', had a hurricane from nw., veering to ne., lasting twelve hours, and causing considerable damage.

Capt. F. Mauley, commanding the s. s. "Borderer," reports, "29th, in N. 49° 20', W. 16° 0' (at noon), from noon to 8 p. m. moderate gale from sw., backing to s.; 10 p. m., encountered a terrific squall, lasting half an hour; barometer 29.50 (749.3); wind hauled to wsw. 30th, 4 a. m., a whole gale from the w., with heavy wind squalls; 8 a. m., fresh gale from wnw. and

hard squalls, accompanied with rain; barometer rising; noon, moderate gale from wnw., barometer rising, sea very high, squalls less severe."

Capt. A. McKay, commanding the s. s. "Catalonia," reports: "29th, 6.20 p. m., off Fastnet, experienced the first of a gale, veering from s. through sw. to w.; 8 p. m., barometer 30.08 (764.0), wind south, strong, and increasing, with drizzling rain and rough southerly swell; midnight, barometer 30.06 (763.5), wind and swell the same. 30th, 4 a. m., barometer 29.92 (760.0), wind s. by w., force 7, high ssw. sea; 8 a. m., barometer 29.77 (756.1), wind ssw., force 8, high sw. sea; noon, in N. 51° 21', W. 14° 0', barometer 29.76 (755.9), wind ssw., force 8, high sw. sea; 4 p. m., similar; 8 p. m., inclined to moderate, barometer 29.82 (756.9), wind wsw., force 6; gale moderated from w. during October 1st."

Mr. H. W. Holland, observer on the s. s. "Bulgarian," Capt. E. Parry, commanding, reports: "29th, in N. 51° 24', W. 16° 55' (at noon), 9 hours, wind commenced to blow in fitful gusts from the se., veering gradually to westward; 16 hours, flew to nnw., and increased in strength; 17 hours, blew a whole gale, accompanied by rain and hail squalls; 19 hours, the wind commenced to moderate, sea very heavy and regular. 30th, 6 hours, took the crew from the bark "Antwerp," of Saint John, New Brunswick, water-logged and masts gone. Captain Dakin, of the "Antwerp," fired his vessel in three places. The "Antwerp" was abandoned in N. 51° 17', W. 22° 1', dead reckoning since leaving the Fastnet." The s. s. "Zaandam," Capt. H. C. von der Zee, commanding, on the 29th and 30th, had a storm from s. veering to n.; lowest barometer, 29.17 (740.9), at 1.45 a. m., in N. 49° 42', W. 16° 35'.

The s. s. "Navarro," Capt. S. de Aldecocea, commanding, on the 29th, in N. 51° 7', W. 20° 30' (at noon), had variable winds from the second quadrant, which increased to strong southerly; the barometer fell to 29.05 (737.9) at 17 hours, and the wind increased to force 10 from the sw.; at 17 hours 15 minutes the wind shifted to ssw. and moderated. Capt. Wm. Tyson, commanding the s. s. "Holland," reports: "Gale commenced at 10 a. m. of the 29th from se., force 6, and continued, with little or no increase in force, until 5 p. m., when the barometer had fallen to 28.88 (733.5), the sea at the time being very confused, and the sky obscured by dark heavy clouds, attended by rain. The wind then suddenly shifted to nne. strong gale. The ship apparently passed through the centre of the storm; lowest barometer, 28.84 (732.5), at 6 p. m., in N. 49° 50', W. 25° 17'. After blowing about eight hours the gale gradually moderated."

The s. s. "Belgenland," Capt. W. A. Beynon, commanding, on the 29th had a strong gale from ne., backing to westerly; lowest barometer, 29.01 (736.8), in N. 50° 40', W. 24° 12'. The s. s. "Iowa," on the 29th, in N. 50° 59', W. 25° 58' (at noon), had a moderate gale, beginning at 4 p. m., from ne.; 8 p. m., fresh gale, nne., high seas and squalls; barometer 29.50 (749.3) at 4 p. m.; gale continued from nne. on the 30th, in N. 50° 20', W. 31° 53' (at noon), with high seas and squalls, backing to n. and nw., and moderating in p. m.

10.—This depression passed eastward over Newfoundland during the night of the 29th and morning of the 30th, with fresh gales and rain to the southward. At noon (Greenwich mean time) of the 30th it was central in about N. 50°, W. 50°, without evidence of special energy.

The following reports describing storms which occurred in the vicinity of the West India Islands during September give the positions in which the disturbances were encountered. It has not been possible, however, to trace the tracks of areas of low pressure which originated in, or traversed portions of, that region during the month. A fairly well-defined depression apparently passed westward south of Hayti and Cuba during the 16th, 17th, and 18th, and entered the southern portion of the Gulf of Mexico on the 19th:

Capt. J. H. Bennett, commanding the s. s. "Edith Godden," reports: "15th, from N. 21°, W. 74° 18' to N. 30°, W. 75° 30', had moderate gales and strong easterly winds, with

heavy squalls and high easterly sea. 16th, noon, barometer 29.85 (758.2); 4 p. m., 29.79 (756.7); 8 p. m., 29.79 (756.7); midnight, 29.79 (756.7). 17th, 8 a. m., barometer 29.74 (755.4); at noon, in N. 23° 06', W. 74° 30', the barometer had risen slightly; 3.30 p. m., heavy and frequent squalls and every appearance of bad weather; 4 p. m., barometer 29.73 (755.1); 6 p. m., barometer 29.70 (754.4), moderate easterly gale, high sea, heavy squalls; gale moderated during the evening; winds continued easterly; 8.30 p. m., barometer 29.73 (755.1), squalls getting heavier and more frequent; 11 p. m., barometer 29.70 (754.4), moderate easterly gale, high sea, e., and heavy squalls."

Capt. R. B. Kelly, commanding the s. s. "Ozama," reports: "September 16th, commenced with fresh sse. wind and cloudy sky; noon, wind freshened, with high sea; 6 p. m., barometer 29.85 (758.2), wind increased to a storm, with tremendous sea; hove ship to, heading east, riding easy. 17th, 4 a. m., in N. 23° 30', W. 70° 45', barometer 29.82 (757.4); 6 p. m., barometer rising. During the last twenty-four hours tremendous rain squalls. 18th, at noon, arrived at Turk's Island. The wind during the storm was from se. to ne."

Capt. Charles Acocks, commanding the bark "Mary," reports: "22d, in N. 24° 40', W. 66° 0' (at noon), had a hard gale from ese. veering to ne., with terrific squalls of wind and rain, and very high cross seas from ese. to ne. 23d, in N. 25° 20', W. 66° 20' (at noon), 2 a. m., hard gale, barometer falling, terrific squalls of wind and rain; 8 a. m., blowing a hurricane, with very hard rain; clouds settling down upon the ship like a pall, and could not see jib-boom end, very heavy cross sea, wind ne., ship's head nnw., barometer falling to 29.25 (742.9), sea sweeping the decks; 1 p. m., barometer slightly higher, terrific hurricane, with rain; 8 p. m., wind backing to n., heavy squalls, barometer 29.40 (746.7); midnight, moderating, squally, with rain. On the 26th, in N. 25° 17', W. 67° 59' (at noon), had very heavy sea from ne., n., and nw.; midnight, hard gale, with heavy squalls, barometer 29.60 (751.8), frightful sea. 27th, in N. 25° 17', W. 67° 30' (at noon), had hard gale, with heavy rain and frightful sea, barometer 29.50 (749.3); vessel shipped seas fore and aft, tearing off all bulwarks; 6 a. m., barometer 29.45 (748.0), hard gale, clouds breaking, wind w. by n., ship's head n. by w. The appearance of the weather at this time was very peculiar, with clouds a slaty gray; noon, barometer 29.60 (751.8), weather clearing to the sw."

Capt. J. B. Zimmer, commanding the brigantine "Pearl," reports: "24th, in N. 25° 40', W. 63° 45' (at noon), barometer falling, weather gloomy and threatening. 25th, at 4 p. m., heavy sw. swell running through a sse. swell; 6 p. m., violent squalls; at night, bluish lightning in the form of balls and big flashes, at an altitude of about 25°, commencing in the ssw. and ending in the ene.; 11 p. m. of the 25th, had Saint Elmo's light at the yard-arms and royal trucks, with heavy rain; barometer falling all day; position at noon of the 25th, N. 26° 38', W. 64° 11'. 26th, day commenced with a ne. wind of great violence and heavy rain, moderating at 6 p. m. to a severe gale; at 8 p. m. the sea began to run very high, breaking heavily; put oil bags overboard; position at noon, N. 26° 38', W. 65° 31'; barometer 29.72 (754.9). 27th, severe gale throughout the day; wind hauling from ene to s., with heavy rain; compelled to use oil bags to save the vessel. Experienced heavy weather until the 30th, in N. 32°, W. 68°."

#### OCEAN ICE.

On chart i are also exhibited the eastern and southern limits of the region within which icebergs and field ice have been reported during September, 1886. These limits have been determined from reports furnished by shipmasters, and from trustworthy data published in the "New York Maritime Register" and other newspapers.

During this month the easternmost ice was encountered on the 21st, in N. 48°, W. 48° 40', by the s. s. "Crystal," and the southernmost ice reported was observed on the 10th, ten miles northeast of Cape Race, by the s. s. "Normandie."



But three icebergs were observed south of the fifty-first parallel. In the Strait of Belle Isle and eastward in the track to longitude 51° bergs were observed at intervals during the month. As is usual at this season of the year, the aggregate number of icebergs observed in the trans-Atlantic track was small; it is noticeable, however, that the quantity of ice encountered on the Banks of Newfoundland during September, 1886, was somewhat less than the average for corresponding months of previous years.

A comparison with the chart for the preceding month (August, 1886), shows the number of icebergs observed to be about the same, and the area within which they appeared to be extended about two degrees to the southward and contracted less than one degree to the westward. A scarcity of ice over the Banks was also a feature for August.

The following table shows the comparison between September, 1886, and the four preceding years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Lon. W.	Month.	Lat. N.	Lon. W.
September, 1882.....	0°	0°	September, 1882.....	0°	0°
September, 1883.....	48 25	47 10	September, 1883.....	49 01	44 35
September, 1884.....	46 00	53 21	September, 1884.....	47 39	49 14
September, 1885.....	45 40	46 22	September, 1885.....	45 40	46 27
September, 1886.....	45 40	53 00	September, 1886.....	45 00	45 40

Icebergs were reported during the month, as follows:

8th and 9th.—The s. s. "Toronto" passed seven icebergs between N. 52° 40', W. 51° 0' and N. 51° 40', W. 56° 10'.

10th.—The s. s. "Normandie," at 9 a. m., passed a small iceberg ten miles northeast of Cape Race.

13th.—The s. s. "Montreal" passed three icebergs in the Strait of Belle Isle.

17th.—The s. s. "Buenos Ayrean," in N. 52° 6', W. 53° 8', at noon, saw an iceberg to the northward; passed one at 4 p. m. thirty miles se. of Belle Isle; also one at midnight off Point Amour. The s. s. "Circassian," in N. 52° 26', W. 53° 0', passed an iceberg; also passed one off Point Amour.

20th.—The schooner "Lady Agnes" collided with a large iceberg thirty-eight miles southeast of Baccalieu Island, or about sixty miles east of Saint John's, at 8 p. m. The schooner was badly damaged and drifted helplessly at sea for seven days, finally reaching Saint John's.

21st.—The s. s. "Crystal," in N. 48° 0', W. 48° 40', passed a medium sized iceberg.

22d.—The s. s. "Sarnia" passed two icebergs one hundred and thirty miles east of Belle Isle.

25th.—The s. s. "Ontario," at 6.35 a. m., passed a large iceberg one hundred and thirty miles east of Belle Isle.

#### FOG.

The following table shows the limits of fog-areas encountered on the north Atlantic Ocean during September, 1886, as reported by shipmasters:

Dates.	Vessel.	Entered.		Cleared.	
		Lat. N.	Lon. W.	Lat. N.	Lon. W.
September 13-14th.....	S. S. "Gallia".....	45 56	47 08	44 12	54 17
September 14-15th.....	S. S. "Galileo".....	44 14	44 0	42 13	47 58
September 15-16th.....	S. S. "Stockholm City".....	46 35	33 38	45 16	45 55

A table similar to the one above will hereafter be a feature of this department; and, as fog is one of the recognized dangers of navigation, it is thought that a continuous record showing the limits within which it has been observed will be of value in determining under what conditions and in what localities it is most likely to be encountered. It is hoped that captains of trans-Atlantic and coasting vessels will co-operate

in this work by giving the positions in which fog banks were entered and cleared.

#### SIGNAL SERVICE AGENCIES.

Signal Service agencies have been established in the Maritime Exchange buildings at New York City and Philadelphia, and in the Custom-House, Boston, where the necessary blanks and other information will be furnished to ship-masters.

In pursuance of the arrangements made with the Meteorological Office of London, England, there were cabled to that office from New York during September, 1886, four reports concerning storms and icebergs encountered by vessels in the Atlantic west of the forty-fifth meridian. Two messages were sent from Boston.

#### TEMPERATURE OF THE AIR.

[Expressed in degrees, Fahrenheit.]

The distribution of mean temperature over the United States and Canada for September, 1886, is exhibited on chart ii by the dotted isothermal lines; and in the table of miscellaneous data are given the monthly mean temperatures, with the departures from the normal, for the various stations of the Signal Service. On chart iv the departures from the normal temperature are illustrated by lines connecting stations of normal or equal abnormal values.

By chart iv it will be seen that the mean temperature of the month exhibits no large departures from the normal; with the exception of Hatteras, North Carolina, Augusta, Georgia, Columbus, Ohio, and five stations along the Gulf coast, the temperature averaged about one degree in excess of the normal over all that portion of the United States lying south of the forty-second parallel and east of the one hundred and third meridian. The mean temperature of Washington Territory and Oregon has also been about one degree higher than the average September. In Maine, New Hampshire, Vermont, the upper lake region, Minnesota, Dakota, the Rocky Mountain region and the southern plateau the mean temperature is slightly below the normal, the largest departures occurring in Minnesota and Dakota.

The following are some of the most marked departures from the normal temperature at Signal Service stations:

Above normal.		Below normal.	
Cairo, Illinois.....	3.9	Duluth, Minnesota.....	5.5
Leavenworth Kansas.....	3.4	Yuma, Arizona.....	4.7
Fort Sill, Indian Territory.....	3.2	Helena, Montana.....	3.0
Omaha, Nebraska.....	3.1	Portland, Maine.....	2.4
Chattanooga, Tennessee.....	2.6	Rio Grande City, Texas.....	2.1
Huron, Dakota.....	2.5	Los Angeles, California.....	2.1
Philadelphia, Pennsylvania.....	2.5	Saint Vincent, Minnesota.....	2.1
Pittsburg, Pennsylvania.....	2.3	Oswego, New York.....	1.8

#### RANGES OF TEMPERATURE.

The monthly, and the greatest and least daily, ranges of temperature, are given in the table of miscellaneous meteorological data.

The following are some of the greatest and least monthly ranges at Signal Service stations:

Greatest.		Least.	
Fort Yates, Dakota.....	71.2	San Diego, California.....	0
Bismarck, Dakota.....	70.1	Hatteras, North Carolina.....	17.7
Poplar River, Montana.....	68.6	Kitty Hawk, North Carolina.....	19.5
Fort Klamath, Oregon.....	68.0	Fort Macon, North Carolina.....	19.9
Moorhead, Minnesota.....	67.4	Cedar Keys, Florida.....	21.1
Huron, Dakota.....	67.0	Pike's Peak, Colorado.....	23.0
Fort Buford, Dakota.....	65.9	Tatooch Island, Washington Ter.....	23.6
Winnemucca, Nevada.....	63.7	Edgartown, Massachusetts.....	24.1

#### DEVIATIONS FROM NORMAL TEMPERATURES.

In the table below are given, for certain stations, as reported by voluntary observers, the normal temperatures for

September for a series of years, the mean temperature for September, 1886, and the departures from the normal :

Station.	County.	Normal temperature for September.	Number of years.	Mean temperature for Sept., 1886.	Departure.
<i>Arkansas.</i>		0		0	0
Lead Hill.....	Boone.....	71.8	5	74.3	+ 2.5
<i>California.</i>					
Sacramento.....	Sacramento.....	67.4	20	65.9	- 1.5
<i>Connecticut.</i>					
Middletown.....	Middlesex.....	61.4	28	62.0	+ 0.6
New Haven.....	New Haven.....	62.7	100	63.9	+ 1.2
Thompson.....	Windham.....	61.4	30	61.6	+ 0.2
<i>Delaware.</i>					
Webster.....	Day.....	64.1	4	58.8	- 5.3
<i>Illinois.</i>					
Anna.....	Union.....	69.3	11	71.2	+ 1.9
Mattoon.....	Coles.....	68.2	6	70.6	+ 2.4
Peoria.....	Peoria.....	67.0	30	69.8	+ 2.8
Riley.....	McHenry.....	60.5	25	60.9	+ 0.4
Sycamore.....	De Kalb.....	63.0	5	61.8	- 1.2
<i>Indiana.</i>					
Lafayette.....	Tippecanoe.....	65.3	7	65.8	+ 0.5
Logansport.....	Cass.....	65.8	31	68.3	+ 2.5
Spiceland.....	Henry.....	63.7	33	65.3	+ 1.6
Vevay.....	Switzerland.....	68.7	21	69.3	+ 0.6
<i>Iowa.</i>					
Clinton.....	Clinton.....	62.1	8	63.9	+ 1.8
Monticello.....	Jones.....	61.5	33	63.0	+ 1.5
<i>Kansas.</i>					
Independence.....	Montgomery.....	70.2	15	71.4	+ 1.2
Lawrence.....	Douglas.....	66.4	19	71.2	+ 4.8
Wellington.....	Sumner.....	68.9	8	71.3	+ 2.4
Yates Centre.....	Woodson.....	67.8	6	69.8	+ 2.0
<i>Maine.</i>					
Belfast.....	Waldo.....	57.6	27	57.0	- 0.6
Bridgton.....	Cumberland.....	58.8	13	59.5	- 0.3
Orono.....	Penobscot.....	57.5	18	56.3	- 1.3
<i>Maryland.</i>					
Fallston.....	Harford.....	65.5	13	67.1	+ 1.6
<i>Massachusetts.</i>					
Amherst.....	Hampshire.....	60.2	49	61.5	+ 1.3
Cambridge.....	Middlesex.....	61.8	64	62.0	+ 0.2
Fitchburg.....	Worcester.....	59.8	30	59.4	- 0.4
New Bedford.....	Bristol.....	59.3	74	62.9	+ 3.6
Somerset.....	Bristol.....	64.3	16	66.4	+ 2.1
Taunton.....	Bristol.....	64.1	16	68.6	+ 4.5
Williamstown.....	Berkshire.....	58.6	31	59.9	+ 1.3
<i>Nevada.</i>					
Carson City.....	Ormsby.....	59.9	7	59.0	- 0.9
<i>New Brunswick.</i>					
Saint John.....	Saint John.....	55.2	26	54.4	- 0.8
<i>New Hampshire.</i>					
Concord.....	Merrimack.....	59.0	19	59.1	+ 0.1
Hanover.....	Grafton.....	57.6	27	56.4	- 1.2
<i>New Jersey.</i>					
South Orange.....	Essex.....	62.6	17	62.6	0.0
<i>New York.</i>					
Factoryville.....	Tioga.....	61.0	5	61.0	0.0
North Volney.....	Oswego.....	60.8	19	61.1	+ 0.3
Palermo.....	Oswego.....	60.6	33	54.9	- 5.7
<i>Ohio.</i>					
Wauseon.....	Fulton.....	62.8	16	63.2	+ 0.4
Westerville.....	Franklin.....	62.3	12	63.6	+ 1.3
<i>Pennsylvania.</i>					
Dyberry.....	Wayne.....	59.2	20	59.9	+ 0.7
<i>South Carolina.</i>					
Stateburg.....	Sumter.....	73.7	6	74.1	+ 0.4
<i>Texas.</i>					
New Ulm.....	Austin.....	77.6	15	77.8	+ 0.2
<i>Vermont.</i>					
Lunenburg.....	Essex.....	56.6	38	58.6	+ 2.0
Newport.....	Orleans.....	58.6	12	56.9	- 1.7
Stratford.....	Orange.....	59.6	12	60.0	+ 0.4
<i>Virginia.</i>					
Bird's Nest.....	Northampton.....	70.4	18	73.7	+ 3.3
Dale Enterprise.....	Rockingham.....	72.8	6	73.9	+ 1.1
Variety Mills.....	Nelson.....	67.0	9	67.5	+ 0.5
Wytheville.....	Wythe.....	63.5	22	65.3	+ 1.8
<i>West Virginia.</i>					
Helvelia.....	Randolph.....	61.5	10	61.9	+ 0.4

\* From the "Bulletin of the New England Meteorological Society."

The following notes, in connection with this subject, are furnished by voluntary observers:

*Indiana.*—Logansport, Cass county: the highest temperature that has occurred in any September during the past thirty-one years was 97°.0, in 1872; the lowest, 33°.0, also in 1872. The highest mean September temperature during the same time was 73°.8, in 1881; lowest mean, 61°.1, in 1868.

Vevay, Switzerland county: during the past twenty-one Septembers the highest temperature, 100°.0, occurred in 1881; the lowest, 36°.0, in 1875.

*Iowa.*—Monticello, Jones county: the highest September temperature during the past thirty-three years, 98°.0, occurred in 1854; the lowest, 26°.0, in 1871. The highest mean temperature for September in the same time, 73°.0, occurred in 1865; the lowest mean, 51°.0, in 1856.

*Maryland.*—Fallston, Harford county: during the past fifteen years the warmest September occurred in 1881, mean temperature, 74°.6; the coldest in 1871, mean, 61°.3.

*New York.*—North Volney, Oswego county: during the past nineteen years

the warmest September occurred in 1881, mean temperature, 69°.2; the coldest in 1871, mean, 55°.7.

*Ohio.*—Wauseon, Fulton county: temperature comparisons for September during the past sixteen years: highest mean, 71°.1, in 1881; lowest mean, 57°.2, in 1883; maximum, 100°.3, in 1881; minimum, 24°.9, in 1871. The mean temperature of the five months ending September 30th, 66°.7, is 0°.3 above the normal.

Westerville, Franklin county: temperature comparisons for September during the past twelve years: highest mean, 71°.1, in 1881; lowest mean, 58°.1, in 1879; average of the maximum temperatures, 85°.9; highest maximum, 95°.5, in 1881; average of the minimum temperatures, 36°.3; lowest minimum, 31°.5, in 1879.

*Virginia.*—Dale Enterprise, Rockingham county: during the past six years the warmest September occurred in 1881, mean temperature, 80°.4; the coldest in 1880, mean, 68°.4.

Wytheville, Wythe county: the highest temperature that has occurred in any September during the past twenty-two years was 96°.0, in 1881; the lowest, 32°.0, in 1879. The mean temperature of the nine months ending September 30th, 37°.6, is 4°.6 above the normal.

Variety Mills, Nelson county: during the past eight Septembers the highest mean temperature, 75°.2, occurred in 1881; the lowest mean, 62°.8, in 1879.

In the following table are given the mean temperatures for the several geographical districts, with the normals and departures, as deduced from Signal Service observations:

#### Average temperatures for September.

Districts	Average for September, Signal-Service observations.		Comparison of Sept., 1886, with the average for several years.
	For several years.	For 1886.	
	0	0	0
New England.....	61.9	61.7	- 0.2
Middle Atlantic States.....	67.9	69.1	+ 1.2
South Atlantic States.....	74.0	74.8	+ 0.8
Florida Peninsula.....	79.6	79.9	+ 0.3
Eastern Gulf States.....	74.9	76.1	+ 1.2
Western Gulf States.....	75.6	76.6	+ 1.0
Rio Grande Valley.....	80.6	78.7	- 1.9
Tennessee.....	70.2	71.6	+ 1.4
Ohio Valley.....	67.2	68.1	+ 0.9
Lower Lake region.....	63.1	63.4	+ 0.3
Upper Lake region.....	58.9	58.2	- 0.7
Extreme Northwest.....	54.9	52.5	- 2.4
Upper Mississippi Valley.....	64.6	65.9	+ 1.3
Missouri Valley.....	61.7	64.1	+ 2.4
Northern slope.....	55.4	54.5	- 0.9
Middle slope.....	63.8	63.6	- 0.2
Southern slope.....	70.0	72.2	+ 2.2
Southern plateau.....	70.6	69.5	- 1.1
Middle plateau.....	62.2	61.0	- 1.2
Northern plateau.....	57.8	58.4	+ 0.6
North Pacific coast region.....	59.0	60.2	+ 1.2
Middle Pacific coast region.....	62.1	61.9	- 0.2
South Pacific coast region.....	74.5	72.1	- 2.4

#### FROSTS.

Frost formed in the various states and territories during the month, as follows:

*Arizona.*—Prescott, 28th.

*California.*—Blue Lake, 4th, 21st, 23d, 26th; Fort Bidwell, 24th.

*Colorado.*—Pike's Peak, 2d, 3d, 7th to 10th, 16th, 24th to 28th; Fort Lewis, 17th, 26th, 27th; Denver, 17th, 28th; Montrose, 28th, 29th, 30th.

*Connecticut.*—North Colebrook, 2d, 3d, 14th, 21st, 22d, 30th; New London and New Haven, 21st; Voluntown, 22d.

*Dakota.*—Fort Totten, 1st, 12th, 16th, 18th, 20th, 30th; Bismarck, 12th, 18th, 20th, 30th; Fort Yates, 16th, 17th, 18th, 30th; Fort Buford, 16th, 19th, 28th, 30th; Pembina, 17th; Webster, 17th, 27th, 28th, 30th; Deadwood, 25th, 29th; Yankton, 28th, 29th, 30th; Huron, 30th.

*Idaho.*—Boise City, 5th to 8th, 24th to 29th.

*Illinois.*—Chicago, 13th; Geneseo, 16th, 19th, 28th; Collinsville, Riley, Sandwich, South Evanston, Sycamore, and Windsor, 29th.

*Indiana.*—Lafayette, 20th; Sunman, 21st, 29th, 30th; Logansport, 29th; Greencastle and Spiceland, 29th, 30th; Indianapolis, 30th.

*Iowa.*—Urbana, 8th, 14th, 18th; Dubuque, 13th; Monticello, 14th, 29th; Manchester, 14th, 28th, 29th; Independence, 17th, 28th, 29th; Cedar Rapids, 17th, 28th, 29th, 30th; Oskaloosa,



17th, 27th to 30th; Davenport, Des Moines, and Muscatine, 17th, 29th; Keokuk and Fort Madison, 29th; Bancroft, 30th.

**Kansas.**—Globe, 17th; Westmoreland, 17th, 28th, 29th; Manhattan, 27th, 28th, 29th; Salina, 28th, 29th; Allison, 28th, 29th, 30th; Atchison, 28th; Concordia and Wellington, 29th; Belleville, Elk Falls, and Emporia, 30th.

**Maine.**—Portland, 2d, 3d, 21st, 22d; Orono, 14th, 19th, 21st, 22d, 23d; Cornish and Eastport, 21st, 22d, 23d.

**Massachusetts.**—Westborough, 2d, 3d, 21st, 22d, 30th; Amherst, 2d, 14th, 21st, 22d; Dudley, 20th, 21st; Princeton, Deerfield, and Boston, 21st; Blue Hill Observatory, Milton, and Taunton, 21st, 22d; Cottage City and Somerset, 22d; Heath, 27th, 30th.

**Michigan.**—Grand Haven, 1st; Hudson, 1st, 10th, 11th, 12th, 17th, 29th; Alpena, 1st, 13th, 14th, 20th, 21st, 29th; East Tawas, 1st, 21st, 28th, 30th; Thornville, 1st, 13th, 21st; Traverse City, 12th; Port Huron, 13th, 21st, 29th; Marquette, 14th, 17th, 21st, 28th; Escanaba, 14th, 20th, 28th; Kalamazoo, 18th, 20th, 29th; Detroit, 19th, 20th; Mottville, 20th, 29th; Mackinaw City, 21st, 29th; Lansing, 28th.

**Minnesota.**—Duluth, 1st, 12th, 13th, 14th, 17th; Saint Vincent, 1st, 12th, 13th, 14th, 18th, 19th; Minneapolis, 1st, 28th; Moorhead, 12th, 17th, 18th, 20th, 28th; Saint Paul, 28th; Buffalo, 28th, 30th.

**Missouri.**—Central College, 29th; Centreville, 30th.

**Montana.**—Helena, 5th, 6th, 7th, 28th; Fort Maginnis, 6th; Fort Assinaboine, 6th, 17th; Poplar River, 8th, 13th, 16th, 18th to 30th; Fort Custer, 29th.

**Nebraska.**—Hay Springs, 12th, 19th, 25th, 27th, 28th; Omaha, 17th; Crete, 17th, 28th; Tecumseh, 17th, 28th, 29th; Fort Robinson, 18th, 19th, 24th, 26th, 29th; North Platte, 19th, 28th, 29th; Genoa, 28th, 29th, 30th; Stockham, 29th; Fremont, 29th, 30th; Brownville, 30th.

**Nevada.**—Winnemucca, 5th.

**New Hampshire.**—Nashua, 2d, 14th, 21st, 22d, 30th; Berlin Mills, 2d, 14th, 21st, 25th, 30th.

**New Jersey.**—Dover, 21st; Roseburg, 21st, 24th; Clayton, 21st, 30th; Vineland, 22d; Beverly, 30th.

**New Mexico.**—Fort Stanton, Santa Fé, Gallinas Spring, and Puerto de Luna, 29th.

**New York.**—Lowville, 1st, 22d, 30th; Humphrey, 1st, 29th; Palermo, 2d, 15th, 22d; Albany, 2d, 21st, 22d; Le Roy, 15th; North Volney, 15th, 22d; Factoryville, 20th; Plattsburg Barracks, 22d.

**Ohio.**—Wauseon, 1st, 11th, 13th, 18th, 20th, 21st, 29th, 30th; Napoleon, 1st, 13th, 20th; Tiffin, 1st, 18th, 21st, 30th; Westerville, 1st, 20th; Yellow Springs, 20th, 21st; Garrettsville, 21st, 29th, 30th; North Lewisburg, 21st, 30th; West Milton, 29th, 30th; College Hill, 30th.

**Oregon.**—Fort Klamath, 2d to 8th, 11th to 17th, 20th to 30th; Lakeview, 5th, 23d, 24th, 27th; La Grande, 26th; Roseburg, 27th.

**Pennsylvania.**—Dyberry, 2d, 3d, 14th, 21st, 22d, 30th; Wellsborough, 2d, 30th; Grampian Hills, 21st; Brattleborough, 21st, 22d; Bethlehem and Blooming Grove, 21st, 30th; East Brook, 29th; Philipsburg, 30th.

**Rhode Island.**—Narragansett Pier, 21st.

**Utah.**—Salt Lake City, 27th.

**Vermont.**—Post Mills, 2d, 19th, 21st, 22d, 23d, 25th; Lunenburg, 2d, 21st, 22d; Strafford, 2d, 21st, 22d, 25th; Burlington and Newport, 22d.

**Virginia.**—Rappahannock Station, 21st; Wytheville, 29th; Dale Enterprise, 30th.

**Washington Territory.**—Olympia, Kennewick, and Tacoma, 27th.

**West Virginia.**—Parkersburg, 30th.

**Wisconsin.**—Wausau, 1st, 12th, 13th, 14th, 17th, 20th, 28th, 29th, 30th; Green Bay, 1st, 12th, 13th, 14th, 28th, 29th; Embarras, 3d, 14th, 17th; La Crosse, 14th, 17th, 28th, 29th; Fond du Lac, 14th, 28th, 30th; Milwaukee, 28th; Madison, 29th.

**Wyoming.**—Fort Bridger, 7th; Cheyenne, 25th, 27th, 28th, 29th.

ICE.

During September, 1886, ice formed on calm water at the following places:

**Connecticut.**—Voluntown, 21st.

**Dakota.**—Fort Buford, 16th; Fort Totten, 16th, 18th, 28th; Webster, 28th, 30th.

**Idaho.**—Boisé City, 26th, 27th.

**Minnesota.**—Duluth, ice one-fourth of an inch thick formed during the night of the 29-30th; Saint Vincent, 13th, 28th, 29th; Moorhead, 28th.

Table of comparative maximum and minimum temperatures for September.

State or Territory.	Station.	For 1886.		Since establishment of station.			
		Max.	Min.	Max.	Year.	Min.	Year.
Alabama	Mobile	91.7	54.7	96.0	1881	53.0	1871
Do	Montgomery	91.6	53.9	97.0	75, 77, '84	51.5	1876
Arizona	Prescott	86.0	43.0	100.0	1879	29.0	1880
Do	Fort Apache	88.9	41.7	96.0	1883	32.0	1880, 1882
Arkansas	Fort Smith	97.9	49.3	99.9	1884	39.6	1883
Do	Little Rock	93.5	52.9	97.0	1881	47.0	1881
California	San Francisco	93.9	59.1	92.0	1877	50.9	1874, 1880, 1881, 1882
Do	San Diego	77.7	60.0	101.0	1883	49.5	1882
Colorado	Denver	85.7	29.0	93.0	1878	28.0	1873
Do	Pike's Peak	44.0	21.0	55.0	1875	6.0	1876
Connecticut	New Haven	80.4	40.1	100.0	1881	35.9	1879
Do	New London	79.1	43.3	92.0	1881	37.0	1879
Dakota	Fort Buford	86.0	20.3	100.0	1882	18.0	1883
Do	Yankton	91.7	33.9	100.0	1881	26.0	1876
District of Columbia	Washington City	91.2	47.0	104.3	1881	38.0	1879
Florida	Jacksonville	92.0	66.0	98.0	1875	56.0	1874
Do	Key West	96.9	70.5	95.0	1872	71.5	1883
Georgia	Atlanta	90.0	53.0	90.5	1881	44.0	1879
Do	Savannah	92.7	63.6	96.0	1876, 1877	54.0	1871
Idaho	Boisé City	88.3	27.9	96.0	1878	30.0	1881, 1882
Illinois	Chico	88.5	50.8	97.0	1881	42.0	1876
Do	Chicago	86.3	41.6	93.9	1881	37.0	1872, 1876
Indiana	Indianapolis	90.2	43.3	94.5	1881	35.0	1875
Indian Territory	Fort Sill	94.3	50.1	100.0	1881	44.0	1878
Iowa	Dubuque	91.9	35.2	94.2	1881	33.0	1873
Do	Keokuk	92.1	42.1	97.0	1881	39.0	75, 76, '83
Kansas	Dodge City	90.5	38.0	99.3	1881	30.0	1876
Do	Leavenworth	90.8	40.0	101.0	1882	37.0	1876
Kentucky	Louisville	90.8	43.8	99.0	1881	42.0	1875, 1876
Louisiana	New Orleans	92.0	61.8	92.3	1884	58.0	1871
Do	Shreveport	97.0	54.9	101.0	1881	47.0	1881
Maine	Eastport	76.7	36.8	82.8	1884	35.0	1875
Do	Portland	83.9	36.6	94.5	1881	37.0	1875
Maryland	Baltimore	90.8	50.1	101.0	1881	40.0	1873, 1879
Massachusetts	Boston	84.9	41.0	101.5	1881	34.0	1879
Michigan	Detroit	85.3	42.9	97.0	1884	34.0	1879
Do	Alpena	85.2	32.8	92.0	1881	29.3	1883
Minnesota	Duluth	77.9	30.1	90.0	1874	30.0	1879, 1883
Do	Saint Paul	88.1	33.0	92.0	1874	30.0	1873
Mississippi	Vicksburg	92.3	53.4	98.0	1881	50.0	1875
Missouri	Saint Louis	91.5	47.0	101.5	1881	40.0	1875
Montana	Fort Benton	81.8	31.4	88.1	1885	14.0	1873
Do	Helena	91.0	56.0	101.0	1881	21.0	1880, 1882
Nebraska	North Platte	92.7	39.9	98.8	1881	30.0	1873
Do	Omaha	90.7	27.0	94.0	1878, 1880	22.0	1880, 1881
Nevada	Winnemucca	61.6	11.4	65.0	1880	11.0	1879
New Hampshire	Mount Washington	85.6	49.8	94.0	1880	43.0	1875
New Jersey	Atlantic City	86.6	53.9	101.0	1881	46.0	1875
Do	Sandy Hook	75.2	36.0	90.0	1879	27.0	1880
New Mexico	Santa Fé	83.1	44.4	88.1	1884	35.0	1878
New York	Buffalo	85.9	50.5	100.2	1881	30.0	1872
Do	New York City	90.8	53.3	94.0	1881	43.0	1875
North Carolina	Charlotte	91.2	58.3	96.0	1872	47.0	1879
Do	Wilmington	88.0	44.4	95.0	1881	40.9	1885
Ohio	Cincinnati	87.3	42.2	98.0	1881	38.0	1875
Do	Cleveland	93.0	43.5	90.0	1876	39.0	73, 77, '82
Oregon	Portland	95.5	35.3	90.0	1877, 1879	34.6	1881
Do	Roseburg	92.1	47.5	101.6	1881	35.0	1879
Pennsylvania	Pittsburgh	90.6	51.2	101.5	1881	43.0	1879
Do	Philadelphia	77.7	50.2	86.5	1881	41.5	1883
Rhode Island	Block Island	87.8	60.5	92.5	1881	54.0	1879
South Carolina	Charleston	90.1	52.0	97.1	1881	40.0	1871
Tennessee	Knoxville	90.2	45.0	98.2	1881	41.0	1875
Do	Nashville	91.0	39.5	94.0	1883	37.0	1883
Texas	Fort Davis	89.3	61.2	94.0	1875, 1876	59.0	1875
Do	Galveston	87.7	37.5	93.0	1875	36.0	1881
Utah	Salt Lake City	90.7	50.0	98.3	1881	40.0	1875, 1879
Virginia	Lynchburg	89.4	59.9	96.0	1880	50.5	1875
Do	Norfolk	83.2	31.0	87.0	1882	31.0	1881
Washington Ter.	Spokane Falls	82.6	35.2	81.0	1877, 1879	31.0	1877
Do	Olympia	90.5	36.4	92.0	1873	31.0	1873
Wisconsin	La Crosse	82.4	38.0	94.0	1872, 1874	32.0	1876
Do	Milwaukee	88.0			1875	23.0	1878
Wyoming	Cheyenne						

TEMPERATURE OF WATER.

The following table shows the highest and lowest temperatures of water observed at the several stations; the monthly ranges of water temperature; the average depth at which the observations were made; and the mean temperature of the air:

## Temperature of water for September, 1886.

Station.	Temperature at bottom.		Range.	Average depth, feet and tenths.	Mean temperature of the air at station.
	Max.	Min.			
Atlantic City, New Jersey	74.8	68.7	6.1	10.8	68.5
Alpena, Michigan	70.6	54.7	15.9	11.9	56.0
Augusta, Georgia	81.9	70.2	11.7	7.0	74.7
Baltimore, Maryland	78.1	72.3	5.8	11.4	69.6
Block Island, Rhode Island	69.1	61.4	7.7	8.8	64.8
Boston, Massachusetts	68.2	55.6	12.6	22.3	62.7
Buffalo, New York	70.0	63.9	6.1	13.0	62.7
Canby Fort, Washington Territory	62.0	50.1	11.9	58.8	58.3
Cedar Keys, Florida	86.9	79.9	7.0	8.3	79.4
Charleston, South Carolina	81.2	75.2	6.0	38.2	79.1
Chicago, Illinois	70.2	57.9	12.3	8.6	66.1
Chincoteague, Virginia	79.2	70.8	8.4	3.9	71.0
Cleveland, Ohio	72.4	61.2	11.2	13.7	64.8
Detroit, Michigan	72.7	60.6	12.1	27.6	64.8
Duluth, Minnesota	58.0	43.9	14.1	10.5	50.6
Eastport, Maine	53.0	51.5	1.5	16.1	54.9
Escanaba, Michigan	60.6	52.4	8.2	18.9	53.0
Galveston, Texas	84.3	79.0	5.3	15.1	80.1
Grand Haven, Michigan	72.9	60.7	12.2	18.9	61.6
Jacksonville, Florida	85.1	78.5	6.6	18.0	76.6
Key West, Florida	89.0	82.3	6.7	19.5	83.5
Marquette, Michigan	65.1	55.7	9.4	10.0	57.2
Macon, Fort, North Carolina	81.6	72.1	9.5	14.6	74.8
Marquette, Michigan	62.6	46.4	16.2	12.1	55.1
Milwaukee, Wisconsin	64.8	50.0	14.8	17.7	57.6
Mobile, Alabama	84.8	80.0	4.8	17.7	77.6
New Haven, Connecticut	70.5	64.4	6.1	12.0	64.6
New London, Connecticut	74.2	69.0	5.2	15.4	67.1
New York City	78.4	68.9	9.5	10.5	71.6
Norfolk, Virginia	84.0	79.0	5.0	17.7	79.1
Pensacola, Florida	68.1	54.3	13.8	17.7	58.2
Portland, Maine	67.4	61.0	6.4	50.1	62.3
Portland, Oregon	75.0	61.8	13.2	10.6	65.3
Sandy Hook, New Jersey	74.2	68.2	6.0	12.8	68.0
San Francisco, California	60.8	56.4	4.4	38.2	60.5
Savannah, Georgia	82.2	77.5	4.7	10.7	77.2
Smithville, North Carolina	80.9	77.3	3.6	11.2	75.3
Toledo, Ohio	75.4	63.7	11.7	13.3	63.7
Wilmington, North Carolina	78.7	74.1	4.6	9.3	74.9

\* Observations temporarily suspended.

## PRECIPITATION.

[Expressed in inches and hundredths.]

The distribution of rainfall over the United States and Canada for September, 1886, as determined from the reports of about seven hundred stations, is exhibited on chart iii.

The precipitation for September, 1886, is largely deficient in the Ohio Valley, Tennessee, the east Gulf states, and in all the states bordering on the Atlantic Ocean, especially large deficiencies occur in the south Atlantic states where the rainfall for the month is less than one third the normal amount for September; in the Carolinas it is only one fifth. In the Indian Territory and northern Texas the monthly rainfall is, as it has been during the past six months, largely below the normal, producing in that region a disastrous drought. The precipitation in the extreme northwest, the upper lake region, and the Pacific coast is also below the normal. In the lower lake region, Illinois, the Missouri Valley, Colorado, west Gulf states, and Rio Grande Valley the monthly rainfall is excessive; it is especially heavy in the Rio Grande Valley and west Gulf states. At Brownsville, Texas, the total monthly rainfall is 30.57, while the normal for that place is 5.62; 22.33 of this fell in forty-five hours, during the prevalence of a heavy storm in southeastern Texas from the 20th to 24th. The total rainfall at Galveston, Texas, 13.31, is also worthy of notice; 6.38 of this fell during the 21st, 22d, 23d, 24th.

The following are some of the most marked departures from the normal precipitation at Signal Service stations:

Above normal.	Below normal.
Brownsville, Texas..... 24.95	New River Inlet, North Carolina .... 6.53
Saint Louis, Missouri..... 6.39	Wilmington, North Carolina..... 6.30
Galveston, Texas..... 5.74	Smithville, North Carolina..... 5.99
Rio Grande City, Texas..... 4.91	Fort Macon, North Carolina..... 5.35
Des Moines, Iowa..... 4.54	Pensacola, Florida..... 5.27
Chicago, Illinois..... 4.14	Cedar Keys, Florida..... 4.18
Galveston, Texas..... 3.90	Savannah, Georgia..... 4.05
Springfield, Illinois..... 3.81	Kitty Hawk, North Carolina..... 4.03
Toledo, Ohio..... 3.74	Charleston, South Carolina..... 3.51

## DEVIATIONS FROM AVERAGE PRECIPITATION.

The following table shows, for certain stations, as reported by voluntary observers, the average precipitation for the month of September for a series of years, the precipitation for September, 1886, and the departures from the average:

Station.	County.	Average precipitation for September.	Number of years.	Precipitation for September, 1886.	Departure.
		Inches.		Inches.	Inches.
<b>Arkansas.</b>					
Lead Hill	Boone	3.81	5	8.44	+ 4.63
<b>California.</b>					
Sacramento	Sacramento	0.13	20	0.00	- 0.13
<b>Connecticut.</b>					
Canton	Hartford	3.67	25	2.81	- 0.86
Hartford	Hartford	4.97	15	2.97	- 0.00
Middletown	Middlesex	3.41	26	3.17	- 0.24
New Haven	New Haven	3.58	14	2.35	- 1.23
Wallington	New Haven	3.39	29	2.98	- 0.41
<b>Dakota.</b>					
Webster	Day	3.55	4	1.71	- 1.84
<b>Florida.</b>					
Archer	Alachua	4.18	4	3.05	- 1.13
<b>Illinois.</b>					
Anna	Union	2.71	11	4.33	+ 1.62
Mattoon	Coles	3.25	6	4.73	+ 1.48
Peoria	Peoria	3.49	30	4.68	+ 1.19
Riley	McHenry	3.52	25	2.25	- 1.27
Sycamore	De Kalb	3.91	5	3.23	- 0.68
<b>Indiana.</b>					
Lafayette	Tippecanoe	2.87	7	4.39	+ 1.52
Logansport	Cass	2.98	31	5.90	+ 2.92
Spiceland	Henry	3.37	33	2.47	- 0.90
Vevay	Switzerland	3.43	21	1.47	- 1.96
<b>Iowa.</b>					
Monticello	Jones	4.04	33	2.80	- 1.24
<b>Kansas.</b>					
Independence	Montgomery	3.71	14	5.27	+ 1.56
Lawrence	Douglas	3.55	19	2.34	- 1.21
Wellington	Sumner	4.09	8	2.70	- 1.39
Yates Centre	Woodson	3.97	6	3.85	- 0.12
<b>Maine.</b>					
Gardiner	Kennebec	3.27	48	3.68	+ 0.41
Orono	Penobscot	3.37	18	4.11	+ 0.74
<b>Maryland.</b>					
Fallston	Harford	4.36	16	1.63	- 2.73
<b>Massachusetts.</b>					
Amherst	Hampshire	3.37	51	5.48	+ 2.11
Cambridge	Middlesex	3.55	45	3.46	- 0.09
Chestnut Hill	Middlesex	2.71	11	3.03	+ 0.32
Framingham	Middlesex	2.40	12	3.05	+ 0.65
Lake Cochituate	Middlesex	3.43	35	3.20	- 0.23
Lynn	Essex	2.62	12	3.21	+ 0.59
Mystic Lake	Middlesex	2.54	11	2.87	+ 0.33
New Bedford	Bristol	3.55	73	3.15	- 0.40
Somerset	Bristol	2.67	16	2.00	- 0.67
Taunton	Bristol	2.17	12	2.73	+ 0.56
Williamstown	Berkshire	3.39	19	4.31	+ 0.92
<b>Nebraska.</b>					
Carson City	Ormsby	0.17	8	0.30	+ 0.13
<b>New Brunswick.</b>					
Saint John	Saint John	3.78	26	3.31	- 0.47
<b>New Hampshire.</b>					
Concord	Merrimac	3.32	31	4.25	+ 0.93
Hanover	Grafton	2.87	22	2.71	- 0.16
<b>New Jersey.</b>					
South Orange	Essex	3.56	17	1.00	- 2.56
<b>New York.</b>					
Factoryville	Tioga	2.14	5	3.01	+ 0.87
Palermo	Oswego	4.34	33	3.70	- 0.64
<b>Ohio.</b>					
Wauseon	Fulton	2.39	14	4.47	+ 2.08
<b>Pennsylvania.</b>					
Dyberry	Wayne	2.53	17	5.05	+ 2.53
<b>South Carolina.</b>					
Kirkwood	Kershaw	3.93	20	3.19	- 0.74
Stateburg	Sumter	3.87	6	2.05	- 1.82
<b>Texas.</b>					
New Ulm	Austin	5.84	15	7.81	+ 1.97
<b>Vermont.</b>					
Lunenburg	Essex	3.38	38	3.98	+ 0.60
Newport	Orleans	4.00	12	4.66	+ 0.66
Strafford	Orange	3.51	12	4.52	+ 1.01
<b>Virginia.</b>					
Bird's Nest	Northampton	3.22	18	1.80	- 1.42
Dale Enterprise	Rockingham	6.04	6	1.58	- 4.46
Variety Mills	Nelson	2.72	8	1.42	- 1.30
Wytheville	Wythe	3.44	23	0.48	- 2.96
<b>West Virginia.</b>					
Helvetia	Randolph	3.68	10	4.37	+ 0.69

\* From the "Bulletin of the New England Meteorological Society."

The following notes, in connection with this subject, are furnished by voluntary observers:

**Indiana.**—Logansport, Cass county: the rainfall of September, 1886, 7.08, is greater than that of any other September during the last thirty-one years; that of 1882, 0.24, is less.

**Vevay, Switzerland county:** the greatest rainfall for September during the past twenty-one years was that of 1866, 15.25; the least during the same time was that of 1871, 0.47.

**Iowa.**—Monticello, Jones county: the largest September rainfall during the past thirty-three years, 10.15, occurred in 1881; the least, 0.00, in 1871.



**Kansas.**—Independence, Montgomery county: the total precipitation of the nine months ending September 30th, 22.18, is 8.27 below the average of the same period as deduced from the observations of the preceding thirteen years.

**Lawrence,** Douglas county: the total precipitation of the nine months ending September 30th, 20.22, is 8.64 below the average for the same months of the preceding eighteen years.

**Maine.**—Gardiner, Kennebec county: the total precipitation of the nine months ending September 30th, 26.62, is 17.67 below the average, 44.29, as deduced from the observations of the past forty-seven years.

**Maryland.**—Fallston, Harford county: during the past sixteen years the largest September rainfall, 12.95, occurred in 1876; the least, 0.23, in 1884.

**Ohio.**—Wauseon, Fulton county: the rainfall of September, 1879, 5.29, is the greatest, and that of 1871, 0.55, the least that has occurred in any September during the past fourteen years.

**Texas.**—New Ulm, Austin county: the rainfall of September, 1874, 15.08, is the greatest, and that of 1872, 0.90, the least that has occurred in any September during the past fifteen years.

**Virginia.**—Dale Enterprise, Rockingham county: during the past six Septembers the largest precipitation, 12.24, occurred in 1882; the least, 1.04, in 1885.

**Variety Mills,** Nelson county: during the past eight Septembers the largest precipitation, 7.18, occurred in 1882, and the least, 0.04, in 1884.

In the following table are shown, for the several geographical districts, the normal precipitation for September; the average for September, 1886, and the excess or deficiency as compared with the normal:

Average precipitation for September.

Districts.	Average for Sept., Signal-Service ob- servations.		Comparison of Sept., 1886, with the aver- age for severa years.
	For sev- eral years.	For 1886.	
	Inches.	Inches.	
New England.....	3.27	3.21	— 0.06
Middle Atlantic States.....	3.76	2.14	— 1.62
South Atlantic States.....	6.08	1.84	— 4.24
Florida Peninsula.....	6.51	4.60	— 1.91
Eastern Gulf States.....	4.51	2.28	— 2.23
Western Gulf States.....	4.46	6.15	+ 1.69
Rio Grande Valley.....	4.46	19.39	+ 14.93
Tennessee.....	3.39	3.22	— 0.17
Ohio Valley.....	2.63	2.56	— 0.07
Lower lake region.....	3.05	4.34	+ 1.29
Upper lake region.....	3.59	4.45	+ 0.86
Extreme northwest.....	1.99	1.96	— 0.03
Upper Mississippi Valley.....	3.67	4.85	+ 1.18
Missouri Valley.....	2.73	3.06	+ 0.33
Northern slope.....	1.07	1.33	+ 0.26
Middle slope.....	1.74	1.97	+ 0.23
Southern slope.....	2.40	3.96	+ 1.56
Southern plateau.....	0.96	1.50	+ 0.54
Middle plateau.....	0.62	0.94	+ 0.32
Northern plateau.....	0.81	0.87	+ 0.06
North Pacific coast region.....	1.93	1.36	— 0.59
Middle Pacific coast region.....	0.52	0.05	— 0.47
South Pacific coast region.....	0.05	0.04	— 0.01

## SNOW.

Snow fell in the various states and territories, as follows:

**Colorado.**—Pike's Peak, 1st, 6th, 7th, 8th, 10th, 14th, 24th.

**Dakota.**—Fort Buford, 17th; Bismarck, 18th.

**Michigan.**—Marquette, Mackinaw City, Escanaba, and Kalamazoo, 30th; Traverse City, 13th, 30th.

**Minnesota.**—Saint Vincent, 17th, 29th; Duluth, 30th.

**Montana.**—Fort Shaw and Fort Assinaboine, 5th, 16th; Helena, 5th; Fort Custer, 16th; Poplar River, 17th; Fort Maginnis, 16th, 17th, 27th.

**New Hampshire.**—Mount Washington, 20th.

**New Mexico.**—Santa Fé, 13th.

**Oregon.**—Ashland, 23d.

**Wyoming.**—Cheyenne, 16th.

## MONTHLY SNOWFALLS.

[Expressed in inches and tenths.]

The following monthly snowfalls have been reported:

Mount Washington, New Hampshire, 1.0; Pike's Peak, Colorado, 0.7; Fort Buford, Dakota, trace; Mackinaw City, Traverse City, and Kalamazoo, Michigan, trace; Fort Shaw, Montana, 3.2; Saint Vincent, Minnesota, 0.1; Poplar River, Montana, 0.5; Cheyenne, Wyoming, 0.5.

Table of excessive and greatest monthly precipitation for September, 1886.

Station.	Specially heavy.		Largest monthly.	Amount.	Station.	Specially heavy.		Largest monthly.	Amount.
	Date.	Amt.				Date.	Amt.		
<b>Alabama.</b>					<b>Mississippi—Con.</b>				
Florence.....			6.48		Oxford.....	12	2.06		
Tusculum.....	14	4.71	6.26		Do.....	14	2.04		
<b>Arizona.</b>					Edwards.....	13, 14	4.08		
Fort Apache.....	8	2.10			Vicksburg.....	12, 13	2.87		
<b>Arkansas.</b>					<b>Missouri.</b>				
Pine Bluff.....	13, 14	7.05	9.66		Saint Louis.....	4	2.62	9.60	
Do.....	25	2.22			Do.....	25, 26	3.07		
Texarkana.....	13, 14	3.40	8.65		Shelbina.....			7.50	
Do.....	24, 25	3.00			Macon City.....			7.35	
Lead Hill.....	25	2.60	8.44		Steelville.....			6.15	
Do.....	27	2.49			Central College.....	16	2.09	6.11	
Helena.....	14, 15	5.00	7.00		Centerville.....	27	2.80		
Magnolia.....	13	2.50	6.93		<b>Nebraska.</b>				
Little Rock.....	12, 13	3.61	6.24		Brownville.....	26	3.13	6.36	
Russellville.....	25	3.00			<b>New Hampshire.</b>				
Prescott.....	13, 14	2.24			Mt. Washington.....	26, 29	3.00	8.52	
Monticello.....	13, 14	3.10			Lake Village.....	16, 17	2.07		
Arkansas City.....	27, 28	2.57			Wier's Bridge.....	16, 17	2.34		
<b>Florida.</b>					Wolfborough.....	16, 17	2.56		
Alva.....	11	3.00	8.90		<b>New Mexico.</b>				
Key West.....	3, 4, 5	3.37	7.10		Gallinas Spring.....	7, 8	3.00	7.78	
Limosa.....	1, 2	3.19	6.67		Fort Stanton.....	10, 11	2.01		
Merritt's Island.....	6, 7	2.55	6.22		<b>North Carolina.</b>				
Tallahassee.....	10	3.40			Wake Forest.....	8, 9	3.35		
Jacksonville.....	6, 7	2.58			Raleigh.....	9	2.56		
Fort Meade.....	12	2.10			Hatteras.....	8, 9	3.23		
<b>Georgia.</b>					<b>Ohio.</b>				
Quitman.....			6.85		Sidney.....	23	5.57	9.25	
Saint Mary's.....			6.35		Paulding.....	23, 24	3.90	8.68	
Waynesborough.....	14, 15	4.29			West Milton.....	22	2.00	7.50	
Way Cross.....	11	3.10			Do.....	27, 28	2.50		
<b>Illinois.</b>					Toledo.....			6.17	
Pana.....	16	4.50	8.74		North Lewisburg.....	23	2.60	6.10	
Do.....	25	2.00			Yellow Springs.....	22, 23	2.43		
Philo.....	22	2.12	7.75		Haverly.....	23	3.25		
Greenville.....	25, 26, 27	3.94	7.24		New Alexandria.....	27, 28	3.20		
Springfield.....	16	3.25	7.24		<b>Oregon.</b>				
Do.....	25, 26	2.59			Mount Angel.....	4, 5	5.24	19.17	
Pekin.....	25, 26	2.62	7.05		Do.....	22 to 25	11.87		
Chicago.....	9, 10	2.18	6.93		<b>Pennsylvania.</b>				
Do.....	18, 19	2.08			Dryberry.....	15, 16	2.10		
Mascoutah.....	26, 27	3.60	6.90		Wilkesbarre.....	28, 29	3.10		
White Hall.....			6.74		<b>South Carolina.</b>				
Martinsville.....	27, 28	5.25	6.40		Blackville.....	15	2.55		
Griggsville.....	16	2.05	6.36		Florence.....	21	2.42		
Do.....	25, 26	2.75			Yemassee.....	9	2.40		
Eberle.....			6.16		<b>Rhode Island.</b>				
Centralia.....	27, 28	2.40	6.16		Block Island.....	23	3.23		
Sandwich.....	19	2.54			<b>Tennessee.</b>				
Melvin.....	16	2.10			Paris.....	28	2.80	6.36	
Decatur.....	16	2.80			Memphis.....	14, 15	2.64	6.20	
Vandalia.....	22, 23	2.64			<b>Texas.</b>				
Collinsville.....	25, 26	2.60			Brownsville.....	21, 22	22.23	30.57	
Sumner.....	26, 27	2.5			Columbia.....	13, 14	2.93	15.86	
Carlyle.....	27	2.32			Do.....	20 to 25	9.50		
Goldsboro.....	27	2.10			Galveston.....	13	2.29	13.31	
<b>Indiana.</b>					Do.....	21 to 24	6.38		
Fort Wayne.....	22, 23	3.50	9.25		Houston.....	13, 14	2.77	12.83	
Greencastle.....	26, 27	2.97			Do.....	23, 24	6.00		
<b>Iowa.</b>					Do.....	27, 28	2.59		
Des Moines.....	25	2.01	7.93		Austin.....	12	5.07	12.33	
Manchester.....	26, 27	2.25	6.76		Sour Lake.....	24	2.70	8.93	
<b>Kansas.</b>					Do.....	28	2.35		
Belleville.....	2, 3	2.05			Rio Grande City.....	21, 22	4.02	8.21	
W. Leavenworth.....	17	2.30			New Ulm.....	13, 14	3.05	7.81	
Independence.....	3, 4	4.82			Do.....	24	2.83		
Elk Falls.....	3, 4	3.65			Brenham.....	24	3.47	7.27	
<b>Louisiana.</b>					Palestine.....	24	4.44	7.12	
Alexandria.....	14	2.87	8.56		Fort Ringgold.....	22, 23	3.60	6.82	
Grand Coteau.....	27	2.50			Hearne.....	13	4.00	6.50	
Liberty Hill.....	13	2.10			Dallas.....	12, 13	3.10	6.29	
Lafayette.....	14	2.31			Silver Falls.....	23, 24	3.84		
Shreveport.....	13	2.73			Belton.....	14, 15	3.08		
<b>Michigan.</b>					Huntsville.....	24	2.15		
Mottville.....			7.88		Luling.....	14, 15	3.25		
Traverse City.....			7.61		Tyler.....	13, 14	2.00		
Pentwater.....	23, 24	3.26	6.65		Do.....	24, 25	2.00		
Hudson.....			6.21		Waco.....	13	3.10		
Lansing.....	8, 9	2.36	6.05		<b>Virginia.</b>				
Grand Haven.....	24	2.02			Brunswick.....	9, 10	3.50		
<b>Minnesota.</b>					Norfolk.....	9, 10	2.29		
Duluth.....			6.05		Do.....	12, 13	2.00		
Minneapolis.....	7	3.94			Cape Henry.....	9, 10	3.25		
<b>Mississippi.</b>					Washington Ter.....				
Hernando.....	14, 15	3.64	6.40		Tatoush Island.....	24	2.33		
Lake.....	28	2.00							
Batesville.....	14	2.66							

## SLEET.

Mount Washington, New Hampshire, 20th, 23d.

Pike's Peak, Colorado, 1st.

Grand Haven, Michigan, 30th.

## HAIL.

Saint Vincent, Minnesota: at 3.38 p. m. of the 5th a heavy thunder-storm set in and continued until 5.05 p. m. The storm was accompanied by hail from 4.19 to 4.30 p. m.; but slight damage was done, owing to the fact that nearly all crops were

Table showing the dates of the first snowfall at stations of the Signal Service, east of the Rocky Mountains, for each winter from 1873-'74 to the winter of 1885-'86, inclusive.

Districts and stations.	Stations established.	Winter of—												
		1873-'74.	1874-'75.	1875-'76.	1876-'77.	1877-'78.	1878-'79.	1879-'80.	1880-'81.	1881-'82.	1882-'83.	1883-'84.	1884-'85.	1885-'86.
New England.														
Eastport, Me.	Apr. 1, 1873	Nov. 10	Nov. 20	Nov. 1	Oct. 15	Oct. 22	Nov. 4	Oct. 24	Nov. 15	Oct. 5	Nov. 20	Nov. 14	Oct. 14	Oct. 31
Portland, Me.	Jan. 15, 1871	Nov. 12	Nov. 20	Nov. 1	Oct. 15	Oct. 22	Nov. 4	Oct. 24	Nov. 15	Oct. 5	Nov. 8	Nov. 14	Oct. 16	Oct. 31
Mount Washington, N. H.	Dec. 1, 1870	"	"	"	"	"	"	"	"	"	"	"	"	"
Boston, Mass.	Nov. 1, 1870	Nov. 10	Nov. 20	Nov. 4	Nov. 19	Nov. 6	Nov. 7	Nov. 3	Nov. 15	Nov. 15	Nov. 17	Dec. 2	Oct. 31	Nov. 19
Block Island, B. I.	Sept. 1, 1880	"	"	"	"	"	"	"	"	"	"	"	"	"
New Haven, Conn.	Dec. 10, 1872	Nov. 13	Nov. 13	Oct. 31	Oct. 15	Nov. 22	Nov. 1	Oct. 24	Nov. 25	Nov. 15	Nov. 17	Dec. 15	Nov. 18	Nov. 23
New London, Conn.	Jan. 10, 1871	Nov. 15	Nov. 20	Nov. 1	Oct. 15	Nov. 5	Nov. 6	Nov. 6	Nov. 25	Nov. 23	Nov. 17	Dec. 16	Nov. 19	Nov. 26
Middle Atlantic states.														
Albany, N. Y.	Dec. 22, 1873	"	Oct. 13	Oct. 31	Oct. 11	Nov. 6	Nov. 6	Nov. 3	Oct. 30	Nov. 20	Nov. 14	Nov. 12	Oct. 25	Nov. 22
New York City	Nov. 1, 1870	Oct. 28	Nov. 20	Oct. 31	Oct. 15	Jan. 4	Nov. 6	Nov. 5	Nov. 24	Nov. 23	Nov. 17	Dec. 16	Nov. 18	Oct. 30
Philadelphia, Pa.	Jan. 1, 1871	Oct. 28	Dec. 1	Oct. 31	Oct. 15	Jan. 29	Dec. 5	Oct. 24	Nov. 24	Nov. 23	Nov. 26	Dec. 19	Nov. 18	Nov. 24
Atlantic City, N. J.	Dec. 10, 1873	"	Nov. 29	Oct. 31	Oct. 15	Jan. 2	Dec. 21	Nov. 4	Nov. 13	Dec. 15	Nov. 29	Dec. 10	Dec. 18	Nov. 24
Barnegat City, N. J.	Dec. 10, 1873	"	Dec. 30	Oct. 31	Oct. 15	Jan. 2	Nov. 7	Nov. 6	Nov. 13	Dec. 15	Nov. 29	Dec. 16	Dec. 18	Dec. 5
Cape May, N. J.	May 24, 1871	"	"	Dec. 15	Dec. 15	Jan. 8	Jan. 31	Nov. 4	Dec. 12	Dec. 15	Nov. 26	Nov. 3	Dec. 18	"
Sandy Hook, N. J.	Dec. 10, 1873	"	Jan. 13	Oct. 31	Oct. 15	Nov. 1	Dec. 5	Nov. 5	Dec. 10	Dec. 15	Nov. 27	Dec. 19	Dec. 18	Dec. 1
Baltimore, Md.	Jan. 1, 1871	Nov. 13	Nov. 13	Oct. 31	Oct. 15	Jan. 4	Dec. 5	Nov. 5	Nov. 13	Oct. 24	Nov. 27	Dec. 17	Nov. 3	Nov. 23
Washington City	Nov. 1, 1870	Oct. 31	Jan. 18	Dec. 15	Nov. 30	Nov. 9	Dec. 8	Nov. 6	Nov. 13	Dec. 15	Nov. 26	Dec. 17	Nov. 6	Nov. 25
Cape Henry, Va.	Dec. 15, 1873	"	Jan. 7	Jan. 31	Oct. 15	Nov. 29	Dec. 17	Dec. 26	Dec. 7	Jan. 1	Jan. 9	Dec. 23	Dec. 18	Jan. 30
Chincoteague, Va.	Mar. 16, 1880	"	"	"	"	"	"	"	"	"	"	"	"	"
Lynchburg, Va.	May 24, 1871	Dec. 5	Nov. 29	Feb. 4	Dec. 30	Dec. 30	Dec. 20	Nov. 20	Nov. 20	Dec. 30	Nov. 28	Dec. 21	Dec. 18	Nov. 26
Norfolk, Va.	Jan. 1, 1871	Dec. 2	Nov. 30	Nov. 30	Dec. 1	Nov. 29	Dec. 17	Dec. 6	Dec. 29	Dec. 30	Nov. 28	Dec. 23	Dec. 18	Jan. 8
South Atlantic states.														
Charlotte, N. C.	Oct. 6, 1878	"	"	"	"	"	Dec. 26	Nov. 19	Dec. 19	Jan. 30	Dec. 17	Jan. 5	Mar. 17	Jan. 8
Hatteras, N. C.	Dec. 1, 1880	"	"	Dec. 24	Dec. 1	Dec. 27	Dec. 27	Jan. 19	Jan. 24	Jan. 1	Dec. 26	Dec. 17	Dec. 19	Feb. 4
Kitty Hawk, N. C.	Jan. 15, 1875	"	"	Feb. 2	Nov. 30	Nov. 30	Dec. 17	Mar. 29	Dec. 10	Jan. 1	Dec. 29	Dec. 17	Dec. 19	Feb. 4
Macon, Fort, N. C.	May 23, 1878	"	"	"	"	"	"	"	"	Jan. 24	Dec. 15	Dec. 17	Mar. 16	Feb. 4
Smithville, N. C.	Oct. 15, 1875	"	"	"	"	"	"	"	"	Jan. 24	"	Jan. 5	"	"
Wilmington, N. C.	Jan. 1, 1871	"	"	"	"	Feb. 3	Jan. 19	Nov. 19	Nov. 15	Jan. 30	"	Jan. 5	"	Feb. 4
Charleston, S. C.	Jan. 5, 1871	"	"	"	"	"	"	"	"	Jan. 30	"	"	"	Feb. 4
Augusta, Ga.	Nov. 2, 1870	Dec. 27	"	Mar. 19	Jan. 1	Jan. 8	Feb. 14	Nov. 19	Dec. 29	Dec. 30	Nov. 20	Jan. 7	Feb. 12	Jan. 9
Savannah, Ga.	Jan. 1, 1871	"	"	"	"	"	"	"	"	Jan. 30	"	"	"	Jan. 9
Jacksonville, Fla.	Sept. 11, 1871	"	"	"	"	"	"	"	"	"	"	"	"	"
Florida Peninsula.														
Cedar Keys, Fla.	Nov. 7, 1879	"	"	"	"	"	"	"	"	"	"	"	"	"
Key West, Fla.	Nov. 1, 1870	"	"	"	"	"	"	"	"	"	"	"	"	"
Sanford, Fla.	Sept. 1, 1882	"	"	"	"	"	"	"	"	"	"	"	"	Jan. 12
Eastern Gulf states.														
Atlanta, Ga.	Sept. 25, 1878	"	"	"	"	"	Dec. 10	Nov. 19	Dec. 29	Dec. 30	Nov. 20	Jan. 5	Dec. 18	Nov. 25
Pensacola, Fla.	Oct. 27, 1879	"	"	"	"	"	"	"	"	"	"	"	"	"
Mobile, Ala.	Nov. 7, 1870	"	"	"	"	"	Jan. 4	"	Jan. 24	"	Jan. 9	"	"	"
Montgomery, Ala.	Nov. 9, 1870	"	Dec. 31	"	Dec. 29	"	Dec. 10	"	Dec. 29	"	Nov. 29	Jan. 8	Feb. 12	Jan. 9
Vicksburg, Miss.	Sept. 10, 1871	Jan. 16	Jan. 4	Feb. 3	Dec. 28	Feb. 10	Jan. 4	Dec. 25	Dec. 28	Dec. 25	Dec. 15	Jan. 1	Dec. 18	"
New Orleans, La.	Nov. 1, 1870	"	"	"	"	Jan. 1	Dec. 26	Jan. 5	Dec. 29	Dec. 25	"	"	"	"
Western Gulf states.														
Shreveport, La.	Sept. 5, 1871	Jan. 15	Jan. 4	"	Dec. 26	Jan. 3	Nov. 26	Dec. 25	Jan. 1	Jan. 29	Jan. 20	Jan. 7	Jan. 16	Jan. 3
Fort Smith, Ark.	June 1, 1882	"	"	"	"	"	"	"	"	"	"	"	"	"
Little Rock, Ark.	July 1, 1879	"	"	"	"	"	"	"	"	Nov. 16	Nov. 20	Jan. 6	Dec. 13	Dec. 12
Galveston, Tex.	Apr. 19, 1871	Jan. 5	"	"	"	"	"	"	"	Jan. 23	"	"	"	Jan. 12
Indianola, Tex.	May 1, 1872	Jan. 5	"	"	"	"	"	"	"	Nov. 17	"	Feb. 3	"	Jan. 12
Palentine, Tex.	Dec. 3, 1881	"	Mar. 6	Mar. 20	Dec. 28	Jan. 3	Dec. 25	Dec. 24	Nov. 5	Jan. 1	Feb. 13	Jan. 16	Jan. 7	Jan. 12
San Antonio, Tex.	Sept. 22, 1875	"	"	"	"	"	Feb. 6	"	"	"	"	"	"	"
Rio Grande Valley.														
Brownsville, Tex.	Aug. 25, 1875	"	"	"	"	"	"	Dec. 25	Dec. 31	"	"	"	"	"
Rio Grande City, Tex.	May 28, 1875	"	"	"	"	"	"	"	"	"	"	"	"	Jan. 12
Ohio Valley and Tennessee.														
Chattanooga, Tenn.	Jan. 8, 1879	"	"	"	"	"	"	"	"	"	"	"	"	"
Knoxville, Tenn.	Jan. 1, 1871	Nov. 12	Dec. 7	Dec. 8	Nov. 8	Dec. 6	Dec. 10	Dec. 25	Dec. 19	Nov. 24	Nov. 29	Dec. 16	Dec. 18	Nov. 24
Memphis, Tenn.	Feb. 28, 1871	Dec. 25	Nov. 28	Dec. 8	Nov. 19	Dec. 5	Nov. 27	Dec. 25	Nov. 13	Jan. 30	Nov. 27	Dec. 19	Dec. 17	Dec. 1
Nashville, Tenn.	Nov. 1, 1870	Oct. 28	Nov. 24	Feb. 1	Nov. 19	Nov. 29	Nov. 27	Dec. 25	Nov. 6	Nov. 24	Nov. 29	Dec. 14	Nov. 28	Nov. 24
Louisville, Ky.	Sept. 11, 1871	Dec. 5	Dec. 7	Dec. 8	Dec. 8	Jan. 3	Dec. 6	Dec. 12	Dec. 9	Dec. 30	Nov. 29	Dec. 16	Nov. 18	Nov. 23
Greencastle, Ind.	July 23, 1884	"	"	"	"	"	"	"	"	"	"	"	"	"
Indianapolis, Ind.	Feb. 10, 1871	Oct. 27	Oct. 30	Nov. 16	Nov. 14	Nov. 5	Oct. 22	Nov. 17	Oct. 17	Nov. 19	Nov. 13	Dec. 14	Nov. 5	Nov. 22
Cincinnati, Ohio	Nov. 1, 1870	Oct. 28	Nov. 20	Oct. 30	Nov. 8	Nov. 28	Oct. 27	Nov. 2	Oct. 17	Nov. 3	Nov. 18	Dec. 14	Nov. 18	Nov. 2
Columbus, Ohio	July 1, 1878	"	"	"	"	"	"	"	"	"	"	"	"	"
Pittsburg, Pa.	Nov. 1, 1870	Oct. 20	Oct. 31	Oct. 30	Oct. 15	Nov. 29	Oct. 31	Oct. 24	Oct. 19	Nov. 4	Nov. 13	Nov. 14	Oct. 23	Oct. 31
Lower lakes.														
Buffalo, N. Y.	Nov. 1, 1870	Oct. 20	Oct. 13	Oct. 17	Oct. 26	Nov. 5	Oct. 31	Oct. 24	Oct. 17	Nov. 4	Nov. 13	Nov. 1	Oct. 23	Oct. 6
Oswego, N. Y.	Nov. 1, 1870	Oct. 29	Oct. 12	Sept. 19	Oct. 8	Nov. 9	Nov. 5	Oct. 24	Oct. 18	Nov. 4	Nov. 13	Oct. 31	Oct. 23	Oct. 30
Rochester, N. Y.	Nov. 1, 1870	Nov. 1	Oct. 13	Nov. 10	Oct. 5	Nov. 5	Nov. 2	Oct. 24	Sept. 14	Nov. 4	Nov. 13	Nov. 2	Oct. 23	Oct. 30
Erie, Pa.	May 25, 1873	Oct. 6	Oct. 30	Oct. 12	Oct. 13	Nov. 3	Oct. 27	Oct. 24	Oct. 17	Nov. 3	Nov. 13	Nov. 1	Oct. 23	Oct. 30
Cleveland, Ohio	Nov. 1, 1870	Oct. 21	Oct. 31	Nov. 1	Oct. 7	Nov. 3	Oct. 27	Oct. 23	Oct. 17	Nov. 3	Nov. 13	Nov. 10	Oct. 23	Nov. 14
Sandusky, Ohio	Aug. 2, 1877	"	"	"	"	"	"	"	"	"	"	"	"	"
Toledo, Ohio	Nov. 1, 1870	Oct. 20	Oct. 29	Oct. 30	Oct. 25	Nov. 3	Oct. 27	Oct. 31	Oct. 17	Nov. 3	Nov. 13	Dec. 15	Oct. 23	Oct. 31
Detroit, Mich.	Nov. 1, 1870	Oct. 20	Oct. 31	Oct. 11	Sept. 26	Nov. 5	Oct. 27	Oct. 24	Oct. 17	Nov. 3	Nov. 13	Nov. 15	Oct. 23	Nov. 14
Upper lakes.														
Alpena, Mich.	Sept. 10, 1873	"	Oct. 14	Sept. 22	Aug. 21	Sept. 21	Sept. 22	Sept. 10	Sept. 22	Oct. 2	Nov. 13	Nov. 13	Oct. 22	Nov. 2
Escanaba, Mich.	May 24, 1871	Oct. 21	Oct. 19	Oct. 10	Oct. 4	Oct. 4	Oct. 18	Oct. 23	Oct. 17	Nov. 18	Nov. 13	Oct. 22	Oct. 22	Oct. 4
Grand Haven, Mich.	May 24, 1871	Oct. 29	Oct. 30	Oct. 11	Oct. 4	Nov. 1	Oct. 26	Oct. 23	Oct. 17	Nov. 3	Nov. 13	Oct. 22	Oct. 22	Oct. 20
Mackinaw City, Mich.	Aug. 20, 1882	"	"	"	"	"	"	"	"	"	"	"	"	"
Marquette, Mich.	May 1, 1871	Oct. 2	Oct. 29	Oct. 3	Sept. 29	Sept. 1	Sept. 21	Sept. 21	Oct. 17	Oct. 9	Oct. 29	Oct. 19	Oct. 22	Oct. 3
Port Huron, Mich.	July 25, 1874	"	"	"	"	"	"	"	"	"	"	"	"	"
Chicago, Ill.	Nov. 1, 1870	Oct. 20	Oct. 30	Oct. 15	Oct. 14	Nov. 2	Oct. 23	Nov. 2	Oct. 16	Nov. 3	Nov. 13	Dec. 16	Oct. 23	Nov. 1
Milwaukee, Wis.	Nov. 1, 1870	Oct. 27	Oct. 30	Oct. 20	Oct. 24	Nov. 1	Oct. 26	Nov. 1	Oct. 17	Nov. 3	Nov. 13	Dec. 14	Oct. 24	Nov. 1
Duluth, Minn.	Nov. 1, 1870	Oct. 19	Oct. 29	Oct. 9	Oct. 3	Oct. 30	Oct. 17	Oct. 30	Oct. 10	Oct. 19	Oct. 29	Oct. 22	Oct. 20	Oct. 19
Upper Mississippi valley.														
Saint Paul, Minn.	Nov. 1, 1870	Oct. 22	Oct. 29	Oct. 25	Oct. 4	Nov. 2	Oct. 17	Nov. 1	Oct. 16	Nov. 2	Nov. 12	Sept. 28	Oct. 22	Oct. 4
La Crosse, Wis.	Oct. 15, 1872	Oct. 22	Oct. 30	Oct. 11	Nov. 6	Nov. 1	Oct. 17	Nov. 1	Oct. 16	Nov. 2	Nov. 12	Oct. 13	Oct. 22	Oct. 20
Davenport, Iowa.	May 24, 1871	Oct. 22	Oct. 30	Oct. 26	Nov. 6	Nov. 1	Oct. 26	Nov. 1	Oct. 16	Nov. 11	Nov. 25	Oct. 24	Nov. 4	Oct. 20
Des Moines, Iowa.	Aug. 1, 1878	"	"	"	"	"	"	"	"	"	"	"	"	"
Des Moines, Iowa.	Aug. 1, 1878	"	"	"	"	"	"	"	"	"	"	"	"	"
Des Moines, Iowa.	Aug. 1, 1878	"	"	"	"	"	"	"	"	"	"	"	"	"



Table showing the dates of the first snowfall at stations of the Signal Service, &amp;c.—Continued.

Districts and stations.	Stations established.	Winter of—													
		1873-'74.	1874-'75.	1875-'76.	1876-'77.	1877-'78.	1878-'79.	1879-'80.	1880-'81.	1881-'82.	1882-'83.	1883-'84.	1884-'85.	1885-'86.	
Missouri Valley.															
Lamar, Mo.	Oct. 17, 1884												d	Nov. 27	
Leavenworth, Kans.	May 21, 1871	Oct. 26	Oct. 30	Oct. 24	Nov. 13	Nov. 7	Nov. 30	Nov. 27	Nov. 14	Nov. 1	Nov. 16	Oct. 24	Nov. 17	Nov. 12	
Omaha, Nebr.	Nov. 1, 1870	Dec. 3	Nov. 18	Oct. 29	Nov. 1	Nov. 4	Oct. 26	Nov. 1	Oct. 13	Sept. 16	Nov. 11	Dec. 16	Nov. 18	Nov. 12	
Valentine, Nebr.	Jan. 27, 1885													Oct. 11	
Bennett, Fort, Dak. g	Dec. 22, 1879								Oct. 26	Oct. 22	Nov. 1	Oct. 20	Oct. 20	Oct. 19	
Huron, Dak.	July 1, 1881									Oct. 12	Nov. 1	Oct. 20	Oct. 20	Oct. 19	
Sully, Fort, Dak.	May 1, 1872													Oct. 5	
Yankton, Dak.	Apr. 1, 1873	Dec. 5	Oct. 28	Oct. 29	Nov. 18	Oct. 28	Oct. 27	Nov. 27	Oct. 15	Nov. 18	Nov. 11	Dec. 22	Oct. 7	Nov. 7	
Extreme northwest.															
Moorhead, Minn. h	Jan. 1, 1881	Oct. 25	Nov. 7	Oct. 14	Oct. 3	Nov. 1	Oct. 16	Oct. 30	Oct. 15	Oct. 14	Oct. 17	Oct. 13	Oct. 21	Oct. 4	
Saint Vincent, Minn. i	Sept. 5, 1880	Sept. 28	Oct. 28	Sept. 19	Oct. 3	Oct. 14	Sept. 20	Oct. 22	Oct. 15	Oct. 12	Oct. 15	Oct. 10	Oct. 21	Oct. 6	
Bismarck, Dak.	Sept. 15, 1874		Oct. 28	Oct. 10	Nov. 2	Oct. 4	Oct. 8	Oct. 22	Oct. 15	Oct. 14	Oct. 11	Oct. 12	Nov. 1	Oct. 5	
Buford, Fort, Dak.	Oct. 23, 1878							Nov. 29	Oct. 9	Oct. 11	Sept. 30	Oct. 11	Oct. 21	Oct. 27	
Totten, Fort, Dak.	Oct. 8, 1883												Oct. 26	Oct. 4	
Northern slope.															
Assinaboine, Fort, Mont.	Oct. 6, 1879								Oct. 9	Sept. 26	Sept. 28	Oct. 9	Oct. 3	Nov. 10	
Benton, Fort, Mont.	Nov. 25, 1871	d	d	d	d	d	d	d	Oct. 14	Oct. 10	Oct. 2	Oct. 9	Oct. 2	d	
Custer, Fort, Mont.	Dec. 5, 1878								Oct. 9	Sept. 30	Oct. 31	Oct. 9	Oct. 19	Nov. 6	
Helena, Mont.	Oct. 15, 1879								Oct. 9	Oct. 11	Sept. 28	Oct. 9	Oct. 1	Oct. 30	
Maginnis, Fort, Mont.	July 14, 1882										d	d	Sept. 6	Sept. 4	
Poplar River, Mont.	May 1, 1882										Sept. 30	Oct. 30	Oct. 20	Oct. 27	
Shaw, Fort, Mont.	Apr. 1, 1880								Oct. 6	Sept. 28	Sept. 28	Aug. 31	Oct. 2	Nov. 10	
Deadwood, Dak.	Dec. 18, 1877						Sept. 29	Sept. 8	Oct. 9	Sept. 5	Oct. 12	Oct. 10	Sept. 29	Sept. 4	
Cheyenne, Wyo.	Nov. 1, 1870	Oct. 15	Oct. 29	Sept. 20	Oct. 30	Oct. 13	Oct. 15	Sept. 9	Oct. 10	Sept. 6	Oct. 6	Oct. 8	Oct. 26	Oct. 3	
North Platte, Nebr.	Sept. 18, 1874		Oct. 29	Oct. 29	Nov. 12	Oct. 28	Oct. 30	Oct. 21	Oct. 15	Nov. 10	Nov. 11	Oct. 10	Oct. 7	Oct. 19	
Middle slope.															
Denver, Colo.	Nov. 19, 1871	Oct. 16	Nov. 17	Oct. 28	Nov. 1	Oct. 15	Oct. 30	Oct. 24	Sept. 25	Oct. 31	Oct. 11	Oct. 10	Oct. 7	Oct. 11	
Pike's Peak, Colo.	Nov. 1, 1873	a	a	a	a	a	a	a	a	a	a	a	a	a	
West Las Animas, Colo.	Oct. 1, 1881											Oct. 17	Dec. 17	Nov. 17	
Concordia, Kans.	Jan. 27, 1885													Nov. 6	
Dodge City, Kans.	Sept. 15, 1874		Oct. 30	Nov. 13	Nov. 1	Oct. 19	Dec. 12	Nov. 27	Oct. 16	Nov. 7	Nov. 12	Dec. 18	Nov. 17	Oct. 18	
Elliott, Fort, Tex.	Nov. 29, 1879								Mar. 12	Nov. 16	Oct. 18	Dec. 31	Dec. 10	Dec. 8	
Southern slope.															
Sill, Fort, Ind. T.	June 23, 1875					Nov. 29	Dec. 13	Dec. 30	Nov. 12	Jan. 16	Nov. 19	d	Dec. 11	Dec. 8	
Abilene, Tex.	Sept. 15, 1885													Jan. 7	
Concho, Fort, Tex. f	Oct. 10, 1875				d	Jan. 3	Dec. 20	Feb. 1	Nov. 15	e	Nov. 18	e	Jan. 15	Jan. 7	
Davis, Fort, Tex.	Dec. 24, 1877						Nov. 16	d	Nov. 5	d	Nov. 17	Dec. 10	Dec. 11	Dec. 8	
Stockton, Fort, Tex.	Feb. 26, 1876				Nov. 22	Dec. 28	Dec. 14	Feb. 2	Nov. 5	Feb. 2	Nov. 15	Dec. 10	Jan. 4	Nov. 18	
Stanton, Fort, N. Mex.	Jan. 1, 1885													Dec. 8	

a Snow every month. b Station closed December 31, 1885. c Station closed October 31, 1885. d No reliable record. e No snow fell. f Corsicana data used prior to 1882-'83. g Station closed November 30, 1885. A Breckenridge data used prior to 1882-'83. i Pembina, Dakota, data used prior to 1880-'81. j Station closed September 15, 1885.

harvested. The stones were round and varied in size from that of a pea to a marble. Heavy rain fell between 4.05 and 5.05 p. m.

Concordia, Kansas: light rain, accompanied by heavy hail, set in at 9.10 p. m. of the 15th; the hail-stones averaged three-eighths of an inch in diameter, the largest measured five-eighths of an inch.

Cerro Gordo, Piatt county, Illinois: a heavy thunder-storm, accompanied by wind and heavy hail, occurred on the afternoon of the 16th. The hail-stones were large and destroyed many window panes. Great damage was done to fruit trees.

Rochelle, Ogle county, Illinois: on the 17th a very severe hail storm occurred in the town and vicinity; some of the stones were seven inches in circumference; numerous windows were broken. The storm although heavy did very little injury to corn, owing to the fact that the crop was nearly matured.

Fort Wayne, Allen county, Indiana: at 4 p. m. of the 22d a severe thunder and hail storm, accompanied by high wind, set in. The hail-stones were large and destroyed numerous window panes.

South Bend, Saint Joseph county, Indiana: on the afternoon of the 22d a heavy hail storm visited this county. Ten thousand window panes were broken in the buildings of the Oliver Plough Works and Studebaker Wagon Factory, slate roofs were considerably damaged. Several persons were injured. The total damage to the town was estimated at \$60,000.

Madison, Wisconsin: a severe hail storm occurred in this vicinity on the morning of the 23d. Numerous windows were broken, and late tobacco suffered considerable damage. Hundreds of birds were killed and shade trees injured. The storm was preceded by heavy rumbling sounds and high temperature.

Batavia, Clermont county, Ohio; shortly after 5 p. m. of the 23d heavy hail fell for fifteen minutes, the stones were as large as quails' eggs. Considerable damage was done to tobacco.

West Sonora, Preble county, Ohio: a severe hail and wind storm passed over this county on the 23d, some of the hail-stones were as large as walnuts.

Liberty, Union county, Indiana: on the afternoon of the 23d a destructive hail and rain storm occurred. The stones varied in size from that of a walnut to an egg; windows, sky-lights, and green-houses were extensively damaged, and stock suffered severely.

Hail was also reported to have fallen in the various states and territories, as follows:

Arizona.—Fort Huachuca, 7th, 21st; Fort Apache, 8th.

Colorado.—Denver, 8th.

Dakota.—Bismarck, 11th; Webster, 14th.

Idaho.—Fort Cœur d'Alene, 25th.

Illinois.—Sycamore and Windsor, 16th; Anna, 19th.

Indiana.—Vevay, 19th; Logansport, 18th, 23d; Fort Wayne, 22d.

Iowa.—Davenport, Fort Madison, and Muscatine, 18th; Des Moines and Oskaloosa, 21st.

Kansas.—Fort Hays, 2d; Westmoreland, 15th; Leavenworth, 19th.

Kentucky.—Richmond, 19th.

Michigan.—Traverse City, 12th; Mottville, 16th, 22d.

Minnesota.—Duluth, 6th; Minneapolis, 15th.

Missouri.—Lamar and Carthage, 16th.

Nebraska.—Genoa, 14th.

New Hampshire.—Nashua, 4th, 15th, 22d.

New Mexico.—Santa Fé, 7th; Lava, 12th.

New York.—Humphrey, 10th, 19th; Oswego, 13th.

Ohio.—Napoleon, 16th; Portsmouth, 19th; Jacksonville, North Lewisburg, and Tiffin, 23d.

Oregon.—Albany, 4th.

Pennsylvania.—Catawissa, 19th.

Texas.—Fort Elliott, 2d.

Utah.—Frisco, 1st.

West Virginia.—Clarksburg, 19th.

Wisconsin.—Milwaukee and Madison, 23d.

Wyoming.—Fort Bridger, 6th.

#### WINDS.

The most frequent directions of the wind during September, 1886, are shown on chart ii by the arrows flying with the wind; they are also given in the table of miscellaneous meteorological data. In the south Atlantic states, east Gulf states, Tennessee, and Florida, the prevailing direction of the wind during September has been from the northeast or east; in the west Gulf states, middle slope, Rio Grande, Mississippi, and lower portion of the Missouri valleys the wind was mostly from the south; in the extreme northwest and upper portion of the Missouri Valley the prevailing direction was northwest; the wind was variable in all other districts.

#### HIGH WINDS.

[In miles per hour.]

Wind-velocities of fifty or more miles per hour were recorded during the month, as follows:

Mount Washington, New Hampshire, 58, nw., 1st; 64, w., 8th; 61, w., 9th; 68, w., 11th; 74, w., 12th; 60, w., 13th; 87, sw., 14th; 60, w., 15th; 67, se., 16th; 79, w., 17th; 93, w., 18th; 100, w., 19th; 90, w., 20th; 64, nw., 21st; 80, w., 24th; 76, w., 25th; 80, w., 26th; 80, w., 27th; 54, s., sw., 28th; 75, sw., 29th.

Pike's Peak, Colorado, 56, w., 2d; 52, nw., 15th; 64, w., 17th; 50, sw., 27th.

Moorhead, Minnesota, 50, s., 14th.

Brownsville, Texas, 68, e., 22d; 52, e., 23d.

#### LOCAL STORMS AND TORNADOES.

New York City: on the 12th, at 5.25 p. m., light rain and thunder-storm, with high wind, set in and continued until 6.55 p. m.; the storm began again at 9 p. m. and ended at 10.10 p. m. Considerable damage was done in the northern part of the city; smoke-stacks were blown down and a number of houses unroofed. This storm was quite severe over Long Island, in northern New Jersey, and in southeastern New York. In Manhattanville considerable damage was done by wind; houses were unroofed and telegraph poles thrown down. At Coney Island fifty-eight bath houses, a railway station, and pavillion were destroyed.

Hartford, Connecticut: a destructive tornado occurred at the town of Burnside, three miles from Hartford, shortly after sunset of the 12th. It travelled from the southwest towards the northeast, making a path about one-eighth of a mile in width through groves of oak, elm, and pine. The tornado was accompanied by a large, black, whirling cloud, and a loud roaring noise.

White Plains, Westchester county, New York: the following is an extract from the report of the observer at this place:

On the 12th the most remarkable rainfall ever recorded at this station occurred. At the time of the shower the wind was perfectly calm; the rain began at 6.15 p. m. and continued about ten minutes, after which the wind began to blow and the rain instantly ceased, during the ten minutes 1.35 inches of rain fell, and in less than ten minutes the sky was clear. During the storm thunder was heard once, lightning distant.

Onancock, Accomack county, Virginia: during the night of the 12-13th, shortly after midnight, a tornado passed over this town, levelling everything in its track to the ground. About midnight the sky was overcast by dark clouds which were illuminated by an almost incessant display of vivid lightning. The storm was preceded by a black funnel-shaped cloud, coming from the southwest, and accompanied by a loud roaring noise. The steeple of a church was blown off, and with it the bell weighing six hundred pounds. Several houses were blown down and many unroofed. The track of the tornado varied in width from fifty to seventy-five yards, its length was about five miles; along this track the largest oak trees were uprooted or broken off near the ground. The town lies between two arms of an estuary of the Chesapeake Bay. In approaching the town the tornado passed over one of these inlets and

raised up a large column of water, forming a water-spout which broke over the lower end of the town with destructive violence. During the day preceding the storm the weather had been unusually warm and oppressive.

Saint Vincent, Minnesota: during the 14th the barometer fell rapidly, reaching a minimum pressure of 29.38 at 11 p. m. In the afternoon the sky became overcast and at 7.35 p. m. heavy rain and thunder-storm set in, the thunder and lightning being almost continuous; several buildings were struck but the damage was slight. At 8.05 p. m. high east wind set in, attaining a maximum velocity of thirty miles at 9.15 p. m.

Lansing, Michigan: a very severe storm prevailed over northern Michigan on the afternoon of the 16th, causing considerable damage to property at all points. At Brighton barns were demolished and orchards injured; in Clinton county houses and barns were wrecked and stacks of hay and wheat blown down and otherwise injured by wind and rain. The effects of the storm were severely felt at Howell, where several houses were blown down and many unroofed. Reports from Lenawee, Clinton, Livingston, and Wayne counties state that the storm was severe, destroying much property in the form of barns, hay-stacks, and fruit trees.

Tolono, Champaign county, Illinois: the storm of the 16th was very destructive and is reported as a tornado which rose and fell alternately as it passed across the county. Fences, trees, and houses were wrecked at some points, while objects at other points (and directly in the path of the tornado) were left undisturbed, owing to the fact that the tornado cloud had ascended from the surface. The cloud touched the ground at the town of Saveri, where a church in process of erection, a large barn, and a warehouse were destroyed.

Terre Haute, Vigo county, Indiana: at 11.30 a. m. of the 16th a tornado occurred at this place, coming from the southwest; the storm continued about fifteen minutes, during which time the air was filled with debris. Numerous large buildings were unroofed, and the rain which followed did great damage. Among the buildings unroofed were the Masonic Hall and a hotel. In the town of Newport, Vermilion county, six buildings were destroyed. The damage done to farm property along the Wabash Valley was estimated at \$90,000. Reports of the severity of this storm have been received from Montezuma, Michigan City, Shelbyville, and various other towns in Indiana.

Tuscola, Douglas county, Illinois: the storm of the 16th was very severe in this county, many barns were blown down, houses unroofed, and large trees uprooted; it was accompanied by heavy rain, overflowing all streams in an unusually short time. The storm was heavy at Woodside, numerous buildings were unroofed and several blown down. The rainfall throughout this section was unusually heavy and was of great value to farmers.

Joliet, Will county, Illinois: at 8.30 p. m. of the 18th a heavy wind storm set in, blowing down numerous houses and uprooting trees. A large grain elevator and several office buildings were levelled to the ground.

Davenport, Iowa: at 5.30 p. m. of the 18th the sky became threatening, with heavy clouds moving rapidly from the southwest, wind-direction southeast. Light rain commenced at 6 p. m.; at 6.45 p. m. the wind veered to the northwest and increased in velocity, heavy rain setting in at the same time. Hail began falling at 6.47 p. m. and continued two minutes, the stones were small and did very little damage. For the five minutes ending at 6.40 p. m. the wind blew at the rate of forty-eight miles per hour from the northwest. The high wind did considerable damage, blowing down chimneys, trees, fences, and signs; telegraphic communication was interrupted, the wires being down in all directions. The storm was quite severe in the surrounding country, blowing down trees, fences, and out-buildings.

Wheaton, Du Page county, Illinois: a heavy storm of wind and rain passed over this county on the night of the 18-19th, commencing at 8 p. m. In the country north of this town much damage was done; several barns and out-houses were demol-



ished and dwellings unroofed or otherwise damaged, numerous windmills and hay-stacks were blown down. Some cattle were killed by falling buildings. The storm was quite severe at De Kalb, the telegraph wires were down and communication was cut off for several hours. A large building was struck by lightning and consumed, loss \$20,000.

Detroit, Michigan: a thunder-storm began at 12.05 a. m. of the 19th. Heavy rain fell between 12.20 and 11 a. m. No damage was done by this storm although the wind for a few minutes blew at the rate of sixty miles per hour from the north. Direction of wind before the storm, southeast; during the storm, north; after, southwest. A westerly gale set in at midday attaining a velocity of twenty-nine miles per hour.

Buffalo, New York: the morning of the 19th opened with heavy rain, the weather continued rainy until the afternoon. Cautionary signals were hoisted at 10.55 a. m. A severe gale from the southwest began at 2 p. m., reaching at 3.55 p. m. a velocity of forty-four miles per hour. The water in the lake was very rough, completely submerging the outer breakwater. No vessel left port during the display of cautionary signals; a number that left before the warning was given were compelled to return, several of them in a disabled condition. In the country about Buffalo many barns were unroofed, while fences, hay-ricks, and fruit trees were thrown down by the gale. Country roads were rendered almost impassable by the heavy rain, which fell continuously during the day.

Oswego, New York: a heavy thunder-storm and high wind occurred on the afternoon of the 19th. The rainfall was heavy between 5 and 5.20 p. m. From 6.50 to 7.15 p. m. the wind blew from the west at the rate of thirty-two miles per hour. A few shade trees were blown down in the city, and considerable fruit destroyed in the country by being blown from the trees.

Sandusky, Ohio: on the 19th a gale began at 1.43 a. m. and ended at 2.45 a. m., began again at 9 a. m. and ended at 6.15 p. m.; maximum velocity, thirty-four miles per hour from the northwest, at 2.05 p. m. Heavy rain, accompanied by thunder and lightning, set in at 1.40 a. m.

Alden Station, Luzerne county, Pennsylvania: this town was visited by a heavy wind and rain storm on the night of the 19-20th. Nearly every building in the town was damaged; several small buildings were completely destroyed. A hotel and a public school building were partially destroyed, and several persons injured.

Wellsborough, Tioga county, Pennsylvania: on the 19th a tornado occurred in Tioga county near Knoxville. The storm destroyed several barns and houses and blew down forest trees. Its track extended over a distance of ten miles. Heavy thunder-storms and high winds were general throughout eastern Pennsylvania on the afternoon of the 19th. At Alden several miners' houses were blown down, and many other buildings unroofed. Farmers suffered considerable loss, the wind unroofing barns and destroying unripe fruit.

Decatur, Indiana: on the afternoon of the 22d a violent wind and rain storm did considerable damage in this town and vicinity. Many buildings were unroofed and small structures demolished. West of the town the storm assumed the form of a tornado and uprooted many acres of forest trees. A heavy storm also occurred on the 24th, destroying fencing and blowing down orchards. In this town much damage was done to the manufacturing interests by the unroofing of buildings. The total damage is estimated at \$50,000.

Cincinnati, Ohio: heavy rain and thunder-storm set in at 5.30 p. m. of the 23d and continued until 6.40 p. m. The storm came from the west and moved toward the southeast and was accompanied by high wind, maximum velocity thirty-two miles per hour. Reports from numerous places show that severe thunder-storms, in some places accompanied by hail and high wind, prevailed throughout the state. At Urbana, in Champaign county, several buildings were unroofed and considerable damage done to fruit and shade trees. The railroad station at Bluffton, and numerous barns in Wyandot, Seneca,

Champaign, and Allen counties were struck by lightning and burned.

Lima, Allen county, Ohio: at 7 a. m. of the 23d a heavy rain and thunder-storm set in. During the storm a large oil tank was struck by lightning and burned, together with a large building and the machinery used in refining the oil; the loss is estimated at \$25,000.

Fort Assinaboine, Montana: fair, cool weather, with brisk and high winds from the southwest and west, prevailed during the 23d. Between 3 and 4 p. m. the wind attained a velocity of forty-one miles per hour. High west winds also prevailed during the 24th and 25th; on the 25th, between 4 and 5 p. m., it blew at the rate of forty miles per hour from the southwest.

Grand Haven, Michigan: heavy rain and vivid lightning set in at 1.02 and continued until 5.05 a. m. of the 24th; amount of rainfall 2.02 inches. Telegraph and telephone lines suffered considerable damage, communication being cut off until 11 a. m. During the storm several houses in the city were struck by lightning. Reports show that the storm was severe throughout the surrounding country, several barns being struck by lightning and burned.

Fort Sill, Indian Territory: a thunder-storm began at 2 p. m. and continued until 4.30 p. m. of the 26th. The storm came from the southwest and was accompanied by heavy rain and high wind, which uprooted one of the post buildings.

#### TORNADO STUDIES FOR SEPTEMBER, 1886.

[Prepared by Lieut. JNO. P. FINLEY, Signal Corps, U. S. Army, Assistant.]

Tornadoes occurred in September on three days, the 12th, 16th, and 18th, as will be seen by reference to the accompanying table, which presents a brief history of each storm and the authority upon which the report is based.

The tornadoes occurring on the 16th were found to be the most destructive as well as the most numerous of the month. In order to invite special attention to the marked disturbances on this day, and graphically present the surrounding atmospheric conditions which were prevailing at the time, chart number vii has been prepared and will be found on the last page of this REVIEW.

Chart number vii is the 3 p. m. (Eastern time) tri-daily weather map of September 16th. The isobars are drawn for every tenth of an inch difference in pressure, and the isotherms for every difference of 10° in temperature. The words "High" and "Low," as used on the chart, indicate the centres of the regions of highest and lowest pressure, respectively. The location and direction of the progressive movement of the tornadoes are shown by the following sign,  $\times \times \times \times \longrightarrow$ , placed upon the chart, and to the southeast of the centre of lowest pressure.

The low-pressure area with which the tornadoes of the 16th were associated was one of the most remarkable depressions of the month. It first appeared in the Saskatchewan Valley, north of Montana, on the afternoon of the 13th. From this locality it moved slowly eastward along the northern boundary of the United States, with little increase in intensity, until the afternoon of the 15th when it was then central in extreme northern Minnesota. On this day a decided change took place in the character of the depression, which inaugurated the conditions of temperature, wind-force, and direction that precipitated the violent local storms of the 16th.

On the morning of the 14th, while the main area was central in Montana, a secondary depression appeared in southern Colorado, which at the expiration of twenty-four hours united with the former in developing a huge and irregular trough of low pressure extending from Lake Superior southwestward to New Mexico. This elongated area increased its major axis to the southwest and northeast, at the same time contracting the shorter axis until the trough reached from the Rio Grande to the fiftieth parallel, north of Lake Superior. The maximum condition was realized on the afternoon of the 16th, and disappeared on the following morning, when the combined depressions were central as a single area in the lower Saint Law-

rence valley. Throughout the entire length of the trough, which bore a singular resemblance to the characteristic funnel shape of the tornado cloud, with the lower end turned backwards and dragging far to the rear, the opposing northerly and southerly winds were well marked, with high temperature gradients.

It is significant to note that the southerly winds along the edge of the trough were attended by measured velocities ranging from 8 to 24 miles per hour, the highest velocities occurring at places from 140 to 230 miles to the southeast of the region of tornado centres. Velocities of from 5 to 15 miles per hour, with southeasterly winds, prevailed at all other stations to the south and east, as far as the Atlantic and Gulf coasts.

On the northern side of the trough the measured velocities, with northwesterly winds, ranged from 5 to 32 miles per hour, the highest velocities occurring northwest of the region of tornado centres, a distance of from 800 to 1,000 miles. The more rapidly the movement of air on opposite sides of the trough towards the centre, the more decided becomes the temperature gradient, and the more marked the conditions of unstable equilibrium in what may be termed the region of meeting of the opposing currents. There must be produced the state of unstable equilibrium to give rise to those conditions which finally conclude in the manifestation of the strong ascensional current and the vortex whirl.

The tornadoes of September 16th occurred in central Illinois, central and northern Indiana, and southern Michigan. Their course of progressive movement was generally from southwest to northeast. The time of formation varied considerably in the three states. In Michigan, from 11.30 a. m. to 1 p. m.; in Indiana, from 11.30 a. m. to 8.15 p. m.; in Illinois, from 11 a. m. to 4 p. m.

Most of the tornadoes appeared at an early hour in the day, between 11.30 a. m. and 1 p. m. The usual time of occurrence is from 2 to 6 p. m., as determined from the averages for many years. The cause of this rather unusual occurrence may be found in the temperature gradient and high wind-velocities that existed as early as 7 a. m., eastern time. From an examination of the tri-daily weather chart for that hour, it was found that the temperature gradient of the tornado region ranged in the extremes from  $2^{\circ}$  to  $5^{\circ}.4$  per geographical degree, the average of several measurements being  $4^{\circ}.5$ . The normal temperature gradient for the 7 a. m. (Eastern time) September charts for several years, for the tornado region, is  $1^{\circ}.47$  per geographical degree. Comparison with the normal, then, shows an extreme departure of  $3^{\circ}.93$ , that is, the temperature at 7 a. m., eastern time, was  $3^{\circ}.93$  per geographical degree above the normal as a maximum, and on the average  $3^{\circ}.03$  above. This was a notable abnormal condition, considering the circumstances of barometric pressure and wind-velocity at the time. Such conditions would seem to justify the expectation of violent local storms for the region in which they prevail.

The most violent, though not the largest number of tornadoes, occurred during the afternoon and evening of the 16th, from 4 to 8.15 p. m. These storms, as well as those which occurred at an earlier hour, have their tracks charted on the 3 p. m. (Eastern time) daily weather map, it being the nearest regular observation to the hour of their occurrence.

The temperature gradient of the tornado region for the 3 p. m. chart ranged in the extremes from  $4^{\circ}$  to  $18^{\circ}.7$  per geographical degree, the average being  $9^{\circ}.02$ . The normal temperature gradient for the 3 p. m. (Eastern time) September charts for several years for the tornado region is  $1^{\circ}.61$  per geographical degree, which, in comparison with the current temperature gradient, shows an extreme departure of  $17^{\circ}.09$ , that is, the maximum temperature gradient at 3 p. m. was  $17^{\circ}.09$  per geographical degree above the normal, and on the average  $7^{\circ}.41$  above. Although the normal temperature gradient at 3 p. m. (Eastern time) was only  $0^{\circ}.14$  per geographical degree above the normal gradient for 7 a. m. (Eastern time), yet the average departure from the normal gradient at 3 p. m. was  $4^{\circ}.38$  per geographical degree greater than at 7 a.

m., and the maximum departure at the former hour was  $13^{\circ}.16$  greater than at the latter. These are marked deficiencies after eliminating the effect of diurnal variations, and probably account for the greater severity of the storms during the afternoon and early evening.

The tornadoes of September 12th occurred near the Atlantic coast, in eastern Virginia, northeastern New Jersey, southeastern New York, and southern Connecticut. The hour of occurrence was from 6 to 8 p. m.

From an examination of the 3 p. m. (Eastern time) tri-daily weather map of this date, the barometric trough is found to extend from the mouth of the Saint Lawrence southwestward to North Carolina. The wind-velocities along the southern edge of the trough ranged from 9 to 20 miles per hour, and on the northern edge from 8 to 30 miles per hour. In the former case the most violent winds were within from 50 to 75 miles of the tornado centres, while in the latter they were distant from 300 to 500 miles.

The temperature gradient of the tornado region at 3 p. m. (Eastern time) ranged in the extremes from  $6^{\circ}.27$  to  $8^{\circ}.08$  per geographical degree, the average of the several measurements being  $7^{\circ}.40$  per geographical degree.

Compared with the normal temperature gradient of that region, as determined from the records of many years, which is found to be  $1^{\circ}.68$  per geographical degree, the maximum departure from the normal is  $6^{\circ}.40$  per geographical degree, the average being  $5^{\circ}.72$ .

The tornadoes of September 18th occurred in southern Missouri and northern Illinois, between the hours of 12 noon and 7.15 p. m.

An examination of the 3 p. m. (Eastern time) tri-daily weather map of this date reveals a narrow barometric trough, lying nearly due east and west, between Utah and Indiana. The wind-velocities along the southern edge of the trough ranged from 5 to 18 miles per hour, the highest being at stations within from 60 to 120 miles of the tornado centres.

The wind-velocities on the northern side of the trough ranged from 5 to 12 miles per hour, the highest being at stations within from 260 to 400 miles of the tornado centres.

The temperature gradient of the tornado region at 3 p. m. (Eastern time) ranged in the extremes from  $5^{\circ}.44$  to  $13^{\circ}.05$  per geographical degree. The normal temperature gradient for this region is found to be  $1^{\circ}.61$  per geographical degree. Compared with the current temperature gradient, we find that the maximum departure for the tornado region is  $11^{\circ}.44$  per geographical degree above the normal, and the average departure  $7^{\circ}.94$  above.

A recapitulation of the above facts and figures is graphically shown in the following table:

Date of storm.	Time.	Velocity of southerly winds.		Velocity of northerly winds.		Temperature gradients per geographical degree, at 3 p. m., eastern time.			
		Distance of maximum velocity from tornado centre.	Miles.	Distance of maximum velocity from tornado centre.	Miles.	Maximum current temperature gradient.	Mean current temperature gradient.	Normal temperature gradient.	Departure from normal.
September 12th ...	6 to 8 p. m.	9-22	50-75	8-30	300-500	8.08	7.40	1.68	5.72-6.40
September 16th ...	11 a. m. to 8.15 p. m.	8-24	147-230	5-32	800-1,000	18.07	9.02	1.61	7.41-17.09
September 18th ...	12 noon to 7.15 p. m.	5-18	60-120	5-12	260-400	13.05	9.55	1.61	7.94-11.44

A brief study is thus presented of the meteorological conditions attending the development of tornadoes on the 12th, 16th, and 18th of September. The prominence necessarily given to wind-direction, wind-velocity, temperature gradient, and the form of areas of low pressure, indicate their importance in a knowledge of the causes incident to tornado formation and the conditions which may justify their prognostication.



Report of tornadoes for the month of September, 1886, by Lieut. J. P. Finley, Signal Corps, U. S. Army, Assistant.

Place.	Date.	Time.	Direction.	Form of cloud.	Number of persons killed.	Number of persons wounded.	Width of path.	Number and kind of animals killed.	Number and kind of buildings destroyed.	Total valuation of property destroyed.	Authority.
Ellington and near Burnside, Connecticut. <sup>a</sup>	12	7 p. m.	n. 30° e.	Basket			Feet. 160 to 330		Some buildings and trees.	\$5,000-\$20,000	Postmasters at Wethersfield and To-land; Geo. H. Goodwin, Burnside, Connecticut; and Wm. A. Eddy, New York City.
Jersey City, New Jersey, Flushing, Brooklyn, and Long Island, New York.	12	6 p. m.	ne.	Funnel	Several				Many		Geo. Quarterman, Flushing, New York.
Onancock, Virginia <sup>b</sup>	12	8 p. m.	ne.	Funnel			40 to 250		Very destructive		B. M. Mears, Keller, F. T. Boggs, Boggs, Boggs' Wharf, and Wm. P. Bell, Accomack, Virginia.
Shelbyville, Illinois	16	11 a. m.	ne.	Funnel		2			Very destructive		J. F. Llewellyn, Mexico, Missouri.
Seymour, Illinois <sup>c</sup>	16	4 p. m.	ne.	Funnel					No serious damage.		E. G. Conkling, Seymour, Illinois.
A few miles south of Springfield, Illinois.	16	4 p. m.	ne.	Funnel							J. F. Llewellyn, Mexico, Missouri.
Tolono, Illinois	16	4 p. m.	ne.	Funnel					1 church, 1 livery stable, and several barns. Timbers were carried through the side of a building 300 feet away.		J. F. Llewellyn, Mexico, Missouri; J. H. Dunlap, Savoy, Illinois.
Savoy, Illinois <sup>d</sup>	16	4 p. m.	ne.	Funnel	None	None	660			2,500	J. H. Dunlap, Savoy, Illinois.
Northwest of Hillsdale and at Sylvania, Indiana. <sup>e</sup>	16	11:35 a. m. to noon.	ne.	Funnel					1 house, 2 barns, and smaller buildings.		Jesse Houchin, Hillsdale, and Joseph C. Swain, postmaster, Sylvania, Indiana.
Three miles south of Covington, Indiana.	16	4 p. m.	ne.	Funnel			Narrow		Much timber and a few buildings.		C. L. Myers, Covington, Indiana.
Terre Haute, Indiana.	16	11:30 a. m.	ne.	Funnel		2			1 hotel, 2 stores, 2 mills, and 5 barns. Very destructive.	135,000	J. F. Llewellyn, Mexico, Missouri; and John F. Boynton, Syracuse, New York.
Dundee, Indiana <sup>f</sup>	16	8:15 p. m.	Easterly	Funnel			2,640		Many		Dr. J. D. Ebert, Dundee, Indiana.
Alamo, Michigan <sup>g</sup>	16	1 p. m.	Easterly	Funnel			Narrow				C. C. Adams, Alamo, Michigan.
Diamondale, Michigan <sup>h</sup>	16	12:30 p. m.	ne.	Whirlwind.							Postmaster at Diamondale, Michigan.
Brady and Wakeshama, Michigan.	16	Noon	ne.						1 church, several barns and windmills.		Ed. Bromley, Detroit, and J. A. Russell, Centerville, Michigan.
Shepardsville and Saint John, Michigan. <sup>i</sup>	16	About noon.	ne.	Funnel					2 houses, 1 school, 2 barns, and many smaller buildings.		W. J. Van Velsar, Shepardsville, and Ed. Bromley, Detroit, Michigan.
Victor Township, Michigan <sup>j</sup>	16	About noon.	Easterly						Houses and barns wrecked.		Ed. Bromley, Detroit, Michigan.
Howell, Michigan <sup>k</sup>	16	1 p. m.	ne.	Funnel	1	Several			Buildings of every description destroyed.	Many thousands of dollars.	Ed. Bromley, Detroit, Michigan.
Brighton, Michigan	16	1 p. m.	ne.						1 church, 8 barns, and many smaller buildings.	\$5,000-\$6,000	Ed. Bromley, Detroit, Michigan.
Half mile northwest of Wakelee, Cassopolis, Barron Lake, Penn. and Marcellus, Michigan. <sup>l</sup>	16	10:30 a. m.	n. 30° e.	Funnel			660 to 1,320		Many		J. M. Hoisington, Marcellus, A. H. Williams, Wakelee, T. R. Barron and T. M. Winchell, Barron Lake, and Francis A. Zerby, Penn. Michigan.
Rice Creek, Michigan <sup>m</sup>	16	11:30 a. m.	ne.	Funnel			660 to 1,320		5 barns, 9 windmills, and a very large amount of timber.		John B. Vernor, Rice Creek, Michigan.
Brooklyn, Michigan <sup>n</sup>	16	About 1 p. m.	Easterly	Funnel					Cloud too high in air to cause much damage.		J. D. De Lameter, Brooklyn, Michigan.
Bath Mills, Michigan	16	About 1 p. m.	ne.						10 houses and a number of barns.		Henry Little, Kalamazoo, Michigan.
Joliet and 9 miles southeast of Plainfield, Illinois. <sup>o</sup>	18	7:15 p. m.	ne.	Funnel	None	Many	50 to 300		20 houses, 10 barns, 2 factories, 1 elevator, 1 school, and many smaller buildings.	75,000	Geo. B. Tilton, Aurora, Jas. W. Boggs, Plainfield, Wm. Osman, Joliet, Illinois; and Henry Little, Kalamazoo, Michigan.
Buffalo, Missouri	18	A. M.	ne.						Very destructive		J. F. Llewellyn, Mexico, Missouri.
Sentinel Prairie, Missouri <sup>p</sup>	18	3:30 p. m.	ne.	Funnel			2,640 to 6,600				J. L. Thurman, Sentinel Prairie, Missouri.

<sup>a</sup> A large black cloud hanging very low and sweeping swiftly over the ground from sw. There was a low, ominous roar, growing louder and louder, a brief lull, and then increasing to the sound of a train of cars rushing through a tunnel.

<sup>b</sup> The cloud had a rising and falling motion and swayed from side to side. Several of the massive stone steps leading up to the church were hurled down to the ground and broken to pieces. A piece of iron casting was blown a distance of three hundred yards and embedded in the ground. In crossing Onancock Creek the cloud gathered up an immense quantity of water, which was thrown to the ground beyond the creek with such violence as to cut holes in the earth.

<sup>c</sup> The cloud was very angry looking, preceded by white scuds in front, some of the points of which were low enough to touch the tops of houses. The funnel cloud was too high in air to cause much danger.

<sup>d</sup> The clouds were observed in w. in rapid contortions, now rising to a considerable height, now descending to the earth. The funnel cloud was very narrow and jumped rapidly from side to side in a swaying motion, causing destruction wherever it touched. Its contortions resembled a greatly troubled sea, rolling and tumbling along. It was accompanied by a loud, roaring noise, like a train of cars; height, probably one hundred feet, and diameter fifty to seventy-five feet.

<sup>e</sup> Funnel cloud was light blue at top, and in front black and ominous, as it rose from the horizon. As it ascended it appeared to drag after it three clouds of similar shape and color. The cloud was accompanied by a loud, roaring noise.

<sup>f</sup> The cloud formed rapidly in the w., being made up from a collection of dark clouds which came from nw. and sw., brought to view about twenty minutes previously by an ordinary gale.

<sup>g</sup> The clouds had two narrow streamers or funnels of a very dark green color. It was accompanied by a loud, roaring noise, like a train of cars shaking the earth.

<sup>h</sup> Light whirling, black clouds, accompanied by a great, roaring noise.

<sup>i</sup> The cloud was accompanied by a loud, roaring noise.

<sup>j</sup> The cloud resembled a huge wheel in the western sky and moved with wonderful rapidity.

<sup>k</sup> The cloud appeared like a great wheel revolving in the western sky.

<sup>l</sup> The cloud had a rising and falling motion and roared like a train of cars. The tornado current was evidently in the form of two cones with apexes united. The nearer the apex junction came to the earth the more destructive the tornado.

<sup>m</sup> The cloud seemed to be very low down and very ragged, and the sky had a dark, greenish tint.

<sup>n</sup> The upper margin of the cloud was very dark, with a multitude of little eddies working toward the centre.

<sup>o</sup> Two clouds from nw. and sw., accompanied by scudding clouds, moved rapidly toward each other. Lightning played freely on both sides of the rapidly approaching cloud. As the clouds met a huge, funnel-shaped cloud extended downward. The cloud acted like a balloon, bobbing up and down and swaying from side to side, but at the same time moving forward at a terrible rate of speed.

<sup>p</sup> At 3:30 p. m. a foamy, vapory, irregular cloud appeared in the sw. For a time it remained apparently stationary, then all at once the southern portion separated from the northern portion and moved eastward very rapidly. The cloud was whitish, tinted faintly with green and purple. In ten minutes it burst upon us in terrific force, destroying everything in its path.

## COTTON REGION REPORTS.

In the following table are given the means of the maximum and minimum temperatures and the average rainfall for the cotton districts during the month of September. For the purpose of comparison, the averages for these districts during the four preceding years are also given. The rainfall, as compared with the averages of four years, is largely deficient in the states of North Carolina, South Carolina, Georgia, Florida, and Alabama; the deficiencies are especially large in the districts of Montgomery, Atlanta, Savannah, and Charleston, producing in those districts a drought which was injurious to some crops but rather favorable for gathering the rapidly opening cotton. The monthly rainfall of the districts of Little Rock and Galveston was more than double the usual amount. The means of the maximum and minimum temperatures are above the average in nearly all districts:

Temperature and rainfall data for the cotton districts, September.

Districts.	Rainfall.			Temperature.								Extremes for Sept., 1886.							
	Average for Septem-ber of four prece-ding years.	Average for Septem-ber, 1886.	Departures.	Maximum.				Minimum.											
				Mean for Sept. of four pre-ceding years.		Mean for Sept., 1886.		Mean for Sept. of four pre-ceding years.		Mean for Sept., 1886.									
				°	°	°	°	°	°	°	°								
	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>																
New Orleans...	2.91	4.14	+ 1.23	87.7	86.8	- 0.9	66.3	68.8	+ 2.5	97	43								
Savannah.....	4.23	1.92	- 2.30	85.3	88.0	+ 1.7	67.1	68.0	+ 1.8	99	43								
Charleston.....	4.60	2.62	- 1.98	84.4	85.7	+ 1.3	64.5	65.6	+ 1.3	96	54								
Atlanta.....	3.08	1.00	- 2.08	83.5	85.4	+ 1.9	63.7	65.2	+ 1.5	95	46								
Wilmington.....	4.79	2.42	- 2.37	82.1	84.4	+ 2.3	61.5	64.8	+ 3.3	97	50								
Memphis.....	2.86	3.95	+ 1.09	84.8	84.5	- 0.3	60.7	63.2	+ 2.5	95	34								
Galveston.....	3.60	8.75	+ 5.15	87.7	88.2	+ 0.5	65.6	69.5	+ 3.9	100	36								
Vicksburg.....	3.46	4.15	+ 0.69	87.3	88.1	+ 0.8	64.1	66.7	+ 2.6	97	48								
Montgomery.....	3.09	0.56	- 2.53	86.1	87.5	+ 1.4	63.4	66.7	+ 3.3	95	38								
Augusta.....	3.09	1.04	- 2.05	84.8	85.8	+ 1.0	65.3	65.8	+ 0.5	96	53								
Little Rock.....	1.95	5.41	+ 3.46	86.1	86.7	+ 0.6	59.4	64.1	+ 4.7	100	40								
Mobile.....	1.99	1.81	- 0.18	88.4	87.5	- 0.9	65.0	65.7	+ 0.7	99	42								

## RAINFALL IN THE TEXAS COTTON REGION.

The following, from the special annual edition of the "Galveston News," of September 1, 1886, containing a tabulated statement and remarks on the rainfall in the Texas Cotton region, from April 1st to October 31st, for the years 1882, 1883, 1884, and 1885, and from April 1st to July 31, 1886, was prepared by Mr. E. O'C. MacInerney, Collector of Customs at Galveston, Texas, from data furnished by the Signal Service:

Station.	1882.	1883.	1884.	1885.	1886.
Austin	13.90	13.38	9.27	10.98	6.41
Beaumont	1.51	8.08	14.81		
Bellton	6.73	10.54	18.76	6.26	11.85
Brenham				3.69	7.99
Columbia			7.83	30.41	5.13
Corvairs	18.18	6.57	20.34	17.06	8.79
Cuero	7.23	12.03	13.39	17.86	6.30
Dallas	23.06	16.56	22.44	22.35	3.31
Galveston	36.40	30.78	36.45	45.96	9.57
Hearne	10.85	12.05	18.40	22.75	7.54
Hempstead	13.04	12.91	21.80		
Houston	18.75	28.94	43.81	18.48	10.66
Huntsville	17.86	15.04	19.66	18.86	9.22
Longview	2.57	1.87	12.98	32.73	9.74
Luling	11.14	13.45	17.20	0.15	2.03
Orange		1.14	7.84	8.38	0.39
Palestine	35.36	30.75	33.37	21.26	7.50
San Antonio	26.24	8.10	11.80	23.57	9.12
Sour Lake	39.73	21.09	28.95	33.63	12.17
Tyler	22.46	16.70	32.27	7.97	4.92
Waco	18.40	8.68	17.82	25.21	4.20
Weatherford	14.08		41.89	19.88	2.04
Weslmer	10.50	11.57	23.95	21.61	7.08
Annual totals	408.16	260.13	477.06	397.95	146.26

The tables are instructive to the extent of showing that in the year 1883 when the rainfall was below the average, the cotton crop for that season was also below the average.

In 1884, while the total amount of rainfall was above the average, its distribution was so uneven as to cause a shortage as marked as if the rainfall had not been up to the average. Of the 477.06 inches reported for the seven months from April 1st to October 31, 1884, 374.25 inches fell during the three months of April, May, and September, leaving but 102.81 inches for the months of June, July, August, and October. Owing to the great evaporating

power of the sun in the months of June, July, and August, they are the months in which the rainfall is the most needed. Any lack of a sufficiency of rain during these three months must necessarily be followed by a proportionate impoverishment of crops, particularly of the cotton crop. Should this assumption be correct, it would be consistent to assume that the cotton crop of Texas for the current year will fall below the expectations of the early spring, but perhaps not so much so as might be expected in comparison with the small rainfall from April 1st to July 31st, viz., April 53.93, May 4.85, June 48.87, and July 38.61 inches, on account of the fact that in June and July it was so much greater than in the two months of April and May.

The Chief Signal Officer recognizes that the reports are not all that they should be, but they are the best that the means at hand can secure. A larger appropriation for this branch of the service has been requested, and those interested in it should see that this feature of the Signal Service work is properly supported.

## NAVIGATION.

## STAGE OF WATER IN RIVERS.

The Ohio River was very low throughout the month; at Louisville, Kentucky, navigation was partially suspended. In the following table are shown the danger-points at the various river stations; the highest and lowest depths for September, 1886, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, September, 1886.

[Expressed in feet and tenths.]

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, Louisiana.....	29.9	30	1.4	12	-1.0	2.4
<i>Arkansas River:</i>						
Fort Smith, Arkansas.....	22.0	15	8.7	1, 2	2.5	6.2
Little Rock, Arkansas.....	23.0	19	6.5	5	2.3	4.2
<i>Missouri River:</i>						
Yankton, Dakota.....	24.0	1, 2	17.8	30	16.6	1.2
Omaha, Nebraska.....	18.0	1 to 4	8.0	25, 30	7.0	1.0
Leavenworth, Kansas.....	20.0	1, 5	6.8	23 to 28	5.6	1.2
<i>Mississippi River:</i>						
Saint Paul, Minnesota.....	14.5	9	2.8	2	2.0	0.8
La Crosse, Wisconsin.....	24.0	24, 25	6.2	15	3.3	2.9
Dubuque, Iowa.....	16.0	29, 30	5.8	18	3.1	2.7
Davenport, Iowa.....	15.0	29, 30	3.8	15 to 18, 22, 23	2.0	1.8
Keokuk, Iowa.....	14.0	30	3.4	1	1.7	1.7
Saint Louis, Missouri.....	32.0	29, 30	7.4	2, 3	5.9	1.5
Calo, Illinois.....	40.0	1	10.2	17	5.3	4.9
Memphis, Tennessee.....	34.0	1, 2	8.4	18, 19, 29, 30	5.4	3.0
Vicksburg, Mississippi.....	41.0	1, 2	8.3	23, 30	4.5	3.8
New Orleans, Louisiana.....	13.0	9	4.2	16, 17, 18, 29	2.7	1.5
<i>Ohio River:</i>						
Pittsburg, Pennsylvania.....	22.0	30	6.9	1	0.8	6.1
Cincinnati, Ohio.....	50.0	1	7.4	18, 19	4.1	3.3
Louisville, Kentucky.....	25.0	3	5.2	16	2.8	2.4
<i>Cumberland River:</i>						
Nashville, Tennessee.....	40.0	20	10.0	14	2.2	7.8
<i>Tennessee River:</i>						
Chattanooga, Tennessee.....	33.0	1	3.4	27 to 30	2.0	1.4
<i>Monongahela River:</i>						
Pittsburg, Pennsylvania.....	29.0	30	6.9	1	0.8	6.1
<i>Savannah River:</i>						
Augusta, Georgia.....	32.0	16	11.0	30	5.9	5.1
<i>Mobile River:</i>						
Mobile, Alabama.....		25	18.8	5, 19	16.7	2.1
<i>Sacramento River:</i>						
Red Bluff, California.....						
Sacramento, California.....		1, 2	8.2	15 to 30	7.5	0.7
<i>Willamette River:</i>						
Portland, Oregon.....		1, 2	3.9	22	1.1	2.8
<i>Colorado River:</i>						
Yuma, Arizona.....		6	18.7	4, 29, 30	15.5	3.2

## FLOODS.

Sioux City, Iowa: heavy rain fell on the afternoon of the 6th, doing much damage. The sewers were inadequate to carry off the volume of water, in consequence of which the streets were flooded, and in some parts of the town houses damaged.

Raleigh, North Carolina: on the 9th heavy rain fell throughout eastern North Carolina, flooding streams and overflowing the lowlands. A large mill dam on Walnut Creek was broken by the pressure of the water and several flouring mills were carried away and bridges wrecked.

Santa Fé, New Mexico: during the 11th, 12th, and 13th heavy rains fell in the region between Socorro and Albuquerque, New Mexico, washing away several miles of the Atchison, Topeka, and Santa Fé Railroad bed. A bridge over the Salida River was badly damaged by the freshet. About twenty-five



adobe houses were destroyed in Socorro and a number washed away in San Marcial.

Reed City, Osceola county, Michigan: a severe thunder-storm prevailed between 4 and 9 p. m. of the 24th. The storm was accompanied by unusually heavy rain which flooded streams and damaged property in this county to the extent of \$50,000. The Grand Rapids and Indiana Railroad was badly washed out between Reed City and Crapo. Several mill dams in the Hersey River broke during the night, considerably increasing the volume of water in the stream and causing several wash-outs along the line of the Flint and P re Marquette Railroad.

#### HIGH TIDES.

Eastport, Maine, 28th, 29th.  
New York City, 28th.  
Smithville, North Carolina, 30th.  
New River Inlet, North Carolina, 3d, 14th.  
Wash Woods, North Carolina, 29th.  
Cedar Keys, Florida, 25th.  
Galveston, Texas, 24th.  
Bainbridge Island, Washington Territory, 28th.

#### LOW TIDES

New River Inlet, North Carolina, 17th.  
Cedar Keys, Florida, 21st.

#### ATMOSPHERIC ELECTRICITY.

##### AURORAS.

Tatoosh Island, Washington, Territory: a white auroral light was seen at 9.10 p. m. of the 9th. The aurora increased in brightness and at 9.40 p. m. it had changed in color from white to a bright yellow and extended from 30° west to 40° east of the magnetic meridian, altitude 15°. Shortly after 10 p. m. numerous well defined streamers appeared. The display continued visible until dawn of the 10th.

Escanaba, Michigan: an auroral light was visible from 1 a. m. until dawn of the 10th; it was again visible at 11 p. m. in the form of several long streamers. The light was obscured by clouds at 12.30 a. m. of the 11th.

Duluth, Minnesota: an auroral light was visible at 11.20 p. m. of the 10th; at 11.30 p. m. beams were quite numerous. The light was obscured by clouds at 1.45 a. m. of the 11th.

Mackinaw City, Michigan: an auroral light was seen at 7.50 p. m. of the 20th; azimuth, 90°; altitude, 20°; color, very light pink.

Eastport, Maine: an auroral arch of about 10° altitude was visible from 7.45 to 10.10 p. m. of the 20th. A faint auroral light was seen from 7.30 p. m. of the 21st until after midnight. An indistinct auroral arch of a dull white color was visible from 11 p. m. of the 29th until 1 a. m. of the 30th.

Alpena, Michigan: a faint auroral light was seen on the northern horizon at 9 p. m. of the 20th; it disappeared at 11.38 p. m.

Fort Buford, Dakota: an arch of auroral light, was seen on the 29th at 10.15 p. m.; extending 15° on each side of the north point of the horizon. The light was visible until after midnight.

Saint Vincent, Minnesota: at 10.25 p. m. of the 30th a white auroral light was seen in the north, rising to an altitude of about 20° and having an azimuth of 90°. The display was not active but remained as first observed until after midnight.

Mackinaw City, Michigan: at 10 p. m. of the 30th an auroral light could be seen through breaks in the clouds. The sky began to clear at 10.30 p. m., showing the light to be of a gray color; altitude 20°; azimuth 75°.

Auroras were also observed during the month, as follows:

8th.—Cambridge, Massachusetts.  
9th.—Vevay, Indiana.  
10th.—Windsor, Illinois; Vevay, Indiana; Bancroft, Iowa; Poplar River, Montana.  
11th.—Bethlehem, Pennsylvania.  
13th.—Fort Totten, Dakota.  
14th.—Wellsborough, Pennsylvania.

15th.—Windsor, Illinois.

17th.—Vevay, Indiana; Duluth, Minnesota.

19th.—Pekin, Illinois.

20th.—Cornish and Orono, Maine; Blue Hill Observatory, Cambridge, and Milton, Massachusetts; Escanaba and Traverse City, Michigan; Nashua, New Hampshire; Embarras, Wisconsin.

21st.—Fort Totten, Dakota; Cambridge, Massachusetts.

22d.—Pekin, Illinois.

23d.—Pekin, Illinois.

27th.—Kalamazoo, Michigan.

29th.—Gardiner and Orono, Maine; Cambridge, Massachusetts; Poplar River, Montana.

30th.—Fort Totten and Webster, Dakota; Bancroft, Iowa; Gardiner and Cornish, Maine; Berlin Mills, New Hampshire; Oswego, North Volney, and Syracuse, New York.

#### THUNDER-STORMS OF SEPTEMBER, 1886.

[By Jr. Prof. H. A. HAZEN.]

The total number of reports during September were, as follows: voluntary observers, 450; Signal Service, 181; special thunder-storm observers, 1,079; making a total of 1,710. The days of greatest frequency were, 10th, 92; 19th, 174; 18th, 108; 19th, 176; 22d, 133, and 23d, 130; and of least, 1st, 10; 4th, 22; 6th, 23; 14th, 11; 20th, 18; 25th, 17; 29th, 14; and 30th, 0. The day of greatest number was the 19th, and, contrary to the usual law, most of these storms occurred not far from 7 a. m. The conditions of pressure, temperature, and wind-direction are exhibited on chart number viii. The figures printed very near the centre of each state indicate the number of storms reported in each case. As the number of stations in Ohio is much greater than in other states, the number of storms has been divided by ten in that state.

#### CHART OF ELECTROMETER READINGS.

[Prepared under the direction of Prof. T. C. MENDENHALL, Assistant.]

Observations have been made during the month of September at the six stations supplied with the necessary apparatus.

At Washington City, the highest indication was given on the afternoon of September 3d, during prevalence of haze. The lowest indication was given on the afternoon of the 26th, during cloudy, windy weather when the barometer was falling rapidly; this is the only date of negative electricity during the month, although there are several dates of very low positive. Rain occurred on the 8th at 11 a. m., during early morning of the 9th, and on the 15th during the 9 a. m. and 1 p. m. observations. All of these dates show at the time of rain much lower values than the average.

On September 7th, during the afternoon, a set of observations was made at the top of the Washington Monument. The wind was light, from the east, the sky nearly covered with cumuli clouds. The values obtained were very steady in character and rather below the average. It was noticed, however, that on grounding the needle, a spark could be obtained, although the potential indicated was less than 300 volts. On several other occasions when sparks have been given in this way the potential indications were very much greater. On several clear days the lowest values of the potential, at which sparks could be obtained, exceeded 700 volts. About 3 p. m. on this date, September 6th, the cumulus clouds disappeared and the sky remained generally clear, excepting a few cirro-stratus clouds and a light haze. This change did not affect the character or value of the indications to any marked extent.

The first diagram of chart vi represents a set of observations made simultaneously at the top of the Washington Monument and at the Instrument Room of the Signal Office on September 21, 1886. The difference in elevation of the two places is about four hundred and fifty feet. It was a bright day, the wind from the northwest, and a trifle hazy. The values obtained at the Monument were much less than might have been expected from the character of the day. On September 26th observations were again made at the Monument, and, as before, the potential values were quite low; the values at the Signal

Table of miscellaneous meteorological data for September, 1886—Signal Service observations.

Stations.	Elevation above sea level.	Atmospheric pressure (in inches and hundredths).					Temperature of the air (in degrees Fahrenheit).										Winds.														
		Mean actual barometer.	Departure from normal.	Mean reduced barometer.	Extremes.		Monthly mean.	Departure from normal.	Extremes.		Monthly range.	Daily ranges.			Mean rel. humidity.	Mean dew-point.	Precipitation.	Departure from normal.	Winds.												
					Highest barometer.	Lowest barometer.			Max.	Min.		Greatest.	Least.	Total movement.					Prevailing direction.	Maximum velocity.											
					Date.	Date.			Date.	Date.		Date.	Date.	Miles p. h.					Direction.	Date.	No. of rainy days.	No. of cloudy days.	No. of fair days.								
<b>New England.</b>																															
Eastport	61	30.03	+ .08	30.10	30.55	29.60	12.0.95	54.9	- 0.7	76.7	61.7	36.8	22	48.1	39.9	20.1	7	3.7	10	76.7	47.7	2.73	- 0.91	5.379	s.	24	e.	20	14	9	10
Portland	99	30.00	+ .07	30.10	30.50	29.60	12.0.90	58.2	- 2.4	83.9	67.2	38.6	22	50.4	45.3	25.2	6	2.2	28	78.1	50.6	5.50	+ 2.70	5.200	nw.	28	sw.	14	15	8	10
Mount Washington	6,279	29.91	+ .06	30.11	30.64	29.60	12.1.18	40.2	- 0.3	61.6	47.6	11.4	22	33.9	50.2	25.5	29	7.1	24	66.4	35.7	8.32	- 0.10	25.060	w.	100	w.	19	16	4	12
Boston	125	29.99	+ .06	30.12	30.49	29.70	12.0.80	62.7	+ 0.5	84.9	70.7	41.0	22	55.5	43.9	20.1	26	4.0	23	74.6	33.3	2.73	- 0.25	7.680	w.	33	w.	20	10	9	11
Block Island	27	30.09	+ .06	30.11	30.43	29.68	12.0.70	64.8	+ 0.7	77.7	69.9	50.2	21	59.9	27.5	15.7	11	5.2	30	86.5	60.4	2.90	- 0.20	8.897	sw.	34	sw.	20	10	6	16
Narragansett Pier								63.7		82.0	71.3	37.0	21	56.1	45.0						55.8	2.35	- 1.33	4.548	s.	24	e.	20	12	9	11
New Haven	107	30.01	+ .06	30.12	30.44	29.68	12.0.76	63.2	- 0.9	80.0	71.6	40.1	21	55.2	44.3	26.5	14	8.6	9	78.6	57.6	3.69	+ 0.44	4.647	n.	24	e.	19	8	7	15
New London	47	30.07	+ .04	30.11	30.46	29.67	12.0.79	64.6	+ 1.3	79.1	71.4	43.3	21	57.3	35.8	27.0	20	6.2	9	79.8	55.8	2.35	- 1.33	4.548	s.	24	e.	20	12	9	11
Edgartown								67.0		80.2	70.5	31.1	2	63.5	24.1						57.6	3.69	+ 0.44	4.647	n.	24	e.	19	8	7	15
<b>Mid. Atlantic States.</b>																															
Albany	83	30.04	+ .06	30.12	30.49	29.68	12.0.81	63.4	+ 0.3	89.0	73.7	40.3	22	53.6	48.7	33.5	3	8.0	23	69.9	52.3	2.51	- 0.85	3.800	s.	26	e.	19	11	7	14
New York City	106	29.96	+ .06	30.13	30.44	29.71	12.0.73	69.1	+ 1.0	85.9	74.9	50.5	21	61.1	35.4	18.9	24	4.2	974.5		58.0	1.79	- 1.66	4.633	s.	27	sw.	26	9	8	10
Philadelphia	117	30.02	+ .06	30.13	30.43	29.71	12.0.72	69.2	+ 2.5	90.6	79.3	51.2	22	60.8	39.4	26.1	17	11.6	9.69.8		57.7	1.20	- 2.12	5.980	s.	38	sw.	26	9	8	10
Atlantic City	13	30.10	+ .04	30.10	30.39	29.73	12.0.66	68.5	+ 1.4	85.6	71.4	49.8	21	62.8	35.8	23.2	21	6.9	18.1.6		62.0	0.89	- 2.45	6.460	e.	22	e.	12	9	4	14
Sandy Hook	28	30.09	+ .04	30.11	30.42	29.69	12.0.73	68.6	+ 1.6	86.6	74.7	53.9	21	63.0	32.7	17.8	28	3.6	9.81.1		62.3	1.06	- 3.30	10.037	s.	40	sw.	26	8	3	19
Baltimore	45	30.09	+ .05	30.12	30.42	29.70	12.0.72	69.6	+ 1.6	90.8	78.5	50.1	21	61.7	40.7	25.1	29	5.1	15.70.5		58.7	1.90	- 1.95	3.442	s.	21	sw.	26	8	5	19
Ocean City								70.3		82.0	71.5	51.5	20	60.2	44.2	25.4	29	6.2	15.73.7		59.7	1.79	- 2.19	3.364	ne.	21	sw.	12	6	5	13
Washington City	106	30.03	+ .05	30.13	30.42	29.72	12.0.70	69.3	+ 1.5	91.2	78.5	47.0	21	60.2	44.2	25.4	29	6.2	15.73.7		59.7	1.79	- 2.19	3.364	ne.	21	sw.	12	6	5	13
Cape Henry	16	30.11	+ .05	30.11	30.35	29.78	12.0.57	72.0	+ 0.0	89.0	77.0	58.6	22	67.7	30.4	20.8	23	2.5	5.78.6		64.5	4.98	- 0.01	9.612	ne.	38	n.	12	6	5	13
Chincoteague	8	30.12	+ .05	30.11	30.37	29.71	12.0.66	71.0	+ 1.0	85.1	76.3	57.2	29	65.1	27.9	18.3	29	7.0	18.79.7		64.1	1.03	- 1.57	7.129	ne.	31	sw.	13	3	10	17
Lynchburg	652	29.96	+ .06	30.13	30.40	29.76	12.0.65	69.5	+ 0.8	80.7	70.3	50.0	14	60.5	40.7	28.9	12	4.9	18.53.4		63.7	1.74	- 1.58	1.761	ne.	12	sw.	13	3	10	17
Norfolk	30	30.11	+ .06	30.12	30.35	29.78	12.0.58	71.6	+ 0.7	89.4	79.1	59.9	21	66.1	29.5	22.2	23	5.6	8.78.1		63.5	4.63	- 0.14	4.254	ne.	21	n.	20	8	6	13
<b>South Atlantic States.</b>																															
Charlotte	808	29.39	+ .06	30.12	30.35	29.80	12.0.55	72.4	+ 1.4	90.8	82.5	53.3	3	62.2	37.5	27.1	28	11.6	8.84.3		67.0	0.66	- 2.58	3.262	ne.	20	sw.	12	7	8	9
Fort Macon	11	30.11	+ .05	30.09	30.28	29.84	12.0.44	74.8	+ 0.3	84.5	80.0	63.4	30	70.2	21.1	14.4	29	5.7	21.83.8		69.4	1.70	- 5.55	9.665	ne.	31	n.	12	7	8	9
Hatteras	12	30.12	+ .06	30.11	30.31	29.83	12.0.48	72.8	+ 0.4	86.1	77.5	60.2	21	70.0	19.9	15.6	27	2.0	3.81.3		66.3	1.92	- 3.23	5.181	ne.	23	ne.	13	4	10	16
Kitty Hawk	9	30.13	+ .04	30.12	30.32	29.81	12.0.51	74.5	+ 0.8	89.0	81.5	61.0	3	67.5	28.0						61.0	1.09	- 4.03	10.865	ne.	38	ne.	20	4	7	12
New River Inlet								75.3	+ 0.8	86.1	78.1	57.3	30	67.1	28.8	19.2	4	8.1	13.82.9		69.4	0.52	- 5.99	6.336	ne.	24	ne.	6	8	13	13
Smithville	34	30.07	+ .04	30.08	30.20	29.84	12.0.42	73.0	+ 0.8	87.0	78.9	61.0	22	67.2	26.0						69.4	0.52	- 5.99	6.336	ne.	24	ne.	6	8	13	13
Wash Woods								74.9	+ 1.5	91.2	81.1	58.3	30	66.7	32.9	24.6	29	3.3	13.78.5		67.1	1.34	- 6.30	3.930	ne.	20	e.	6	7	14	12
Wilmington	52	30.06	+ .04	30.09	30.28	29.84	12.0.44	74.9	+ 1.5	91.2	81.1	58.3	30	66.7	32.9	24.6	29	3.3	13.78.5		67.1	1.34	- 6.30	3.930	ne.	20	e.	6	7	14	12
Charleston	52	30.06	+ .06	30.08	30.25	29.83	12.0.44	74.9	+ 1.5	91.2	81.1	58.3	30	66.7	32.9	24.6	29	3.3	13.78.5		67.1	1.34	- 6.30	3.930	ne.	20	e.	6	7	14	12
Augusta	183	29.94	+ .04	30.10	30.30	29.87	12.0.43	74.7	+ 0.1	94.0	82.0	60.1	3	66.8	34.5	29.0	24	5.0	21.81.7		68.0	0.65	- 3.25	4.771	ne.	17	sw.	12	3	17	10
Savannah	87	30.02	+ .05	30.08	30.24	29.84	12.0.40	77.2	+ 1.4	92.7	82.0	63.6	4	71.0	29.1	18.4	4	8.0	8.82.6		71.1	1.64	- 4.05	4.592	e.	23	e.	6	13	4	12
Jacksonville	43	30.04	+ .05	30.06	30.19	29.86	12.0.32	78.6	+ 0.8	92.0	85.4	60.0	28	73.5	26.0	19.3	28	4.4	3.82.1		72.2	4.91	- 3.07	3.970	ne.	24	e.	18	14	7	15
<b>Florida Peninsula.</b>																															
Cedar Keys	22	30.06	+ .05	30.04	30.16	29.91	12.0.25	79.4	+ 0.2	91.4	86.6	69.4	27	73.1	22.0	19.3	24	6.5	10.78.9		72.0	1.38	- 4.18	6.646	ne.	27	ne.	2	9	8	17
Key West	20	29.98	+ .02	29.96	30.08	29.80	12.0.28	82.5	+ 0.4	96.9	81.0	70.5	3	77.1	26.4	18.6	3	5.0	26.75.3		73.5	7.10	+ 0.59	7.144	ne.	32	e.	17	13	7	18
Sanford	25	30.00	+ .05	29.99	30.11	29.82	12.0.30	79.3	+ 1.2	92.4	87.0	65.5	29	73.7	26.9	24.7	29	7.1	7.80.1		72.0	5.01	- 0.99	5.446	ne.	26	n.	17	13	7	18
<b>Eastern Gulf States.</b>																															
Atlanta	1,139	29.97	+ .05	30.11	30.30	29.91	14.0.39	72.9	+ 1.6	90.0	82.8	53.0	30	64.9	37.0	23.4	30	7.4	21.74.8		63.7	0.53	- 2.74	5.983	e.	22	nw.	12	4	14	14
Pensacola	30	30.02	+ .02	30.01	30.14	29.90	9.0.24	79.1	+ 1.7	89.4	85.8	59.7	30	73.6	29.7	24.2	30	6.1	26.77.6		71.1	1.29	- 5.24	5.586	e.	24	e.	8	10	3	17
Mobile	35	30.03	+ .04	30.03	30.14	29.92	14.0.34	77.6	+ 0.8	91.7	80.3	54.7	30	71.4	37.0	23.5	30	4.6	19.75.2		68.3	2.69	- 2.62	4.983	n.	21	e.	9	7	18	12
Montgomery	219	29.86	+ .04	30.00	30.23	29.89	14.0.34	77.3	+ 1.8	91.7	80.3	53.9	30	69.8	37.7	25.2	30	9.5	10.69.9		65.8	1.12	- 1.81	3.893	n.	30	e.	21	4	15	11
Vicksburg	222	29.83	+ .01	30.03	30.18	29.83	14.0.35	76.7	+ 1.7	92.3	87.1	53.4	30	69.1	38.9	25.4	1	9.1	13.77.5		68.2	5.13	- 0.65	3.925	n.	20	sw.	15	9	6	13
New Orleans	53	29.99	+ .04	30.01	30.10	29.90	9.0.20	77.9	+ 0.1	92.0	85.3	61.8	30	72.7	3																



Table of miscellaneous meteorological data for September, 1886—Signal Service observations—Continued.

Table of miscellaneous meteorological data for September, 1900.																																		
Stations.	Elevation above sea-level.	Atmospheric pressure (in inches and hundredths).					Temperature of the air (in degrees Fahrenheit).										Winds.																	
		Mean actual barometer.	Departure from normal.	Mean reduced barometer.	Extremes.		Monthly mean.	Departure from normal.	Extremes.		Monthly range.	Daily ranges.		Mean rel. humidity.	Mean dew-point.	Precipitation.	Departure from normal.	Total movement.	Prevailing direction.	Maximum velocity.		No. of rainy days.	No. of cloudy days.	No. of fair days.	No. of clear days.									
					Highest barometer.	Lowest barometer.			Max.	Min.		Greatest.	Least.							Miles p. h.	Direction.													
					Date.	Date.			Date.	Date.		Date.	Date.							Date.	Date.													
Upper Miss. Valley.																																		
Saint Paul.	831	29.06	-.02	29.95	30.27	29.50	15.0.78	58.1	0.7	88.1	6	69.2	33.0	30	48.8	55.1	33.7	14	5.6	18	75.4	49.4	3.69	+	0.33	5.393	e.	32	w.	16	12	10	17	3
La Crosse.	725	29.24	+.03	30.01	30.32	29.60	15.0.73	61.8	+.3	90.5	6	70.7	36.4	30	54.5	54.1	28.4	14	5.7	18	79.6	55.0	3.21	+	1.88	5.283	s.	32	nw.	30	11	7	19	4
Davenport.	615	29.36	-.02	29.98	30.29	29.68	15.0.61	65.4	+.1	89.5	6	75.5	37.6	30	57.0	51.9	28.6	13	5.9	1	67.8	53.4	2.43	+	0.92	5.520	s.	34	nw.	18	14	9	14	7
Des Moines.	849	29.10	-.02	29.98	30.28	29.58	15.0.72	65.1	+.1	93.2	6	70.4	37.7	30	57.0	54.5	30.4	29	7.6	8	75.3	59.5	7.93	+	4.54	4.120	sw.	24	w.	16	17	9	16	6
Dubuque.	665	29.30	-.02	29.98	30.28	29.58	15.0.62	63.6	+.1	91.9	6	74.2	35.2	30	54.4	50.7	32.6	29	10.5	8	71.1	57.2	3.10	+	1.77	5.846	s.	20	w.	11	13	7	15	8
Keokuk.	618	29.36	+.01	30.01	30.31	29.69	15.0.62	68.2	+.2	92.1	7	77.8	42.1	30	59.9	50.0	25.1	22	3.6	2	70.4	57.2	3.95	+	0.30	6.331	s.	30	ne.	1	13	5	13	12
Keokuk.	618	29.36	+.01	30.01	30.31	29.69	15.0.62	68.2	+.2	92.1	7	77.8	42.1	30	59.9	50.0	25.1	22	3.6	2	70.4	57.2	3.95	+	0.30	6.331	s.	30	ne.	1	13	5	13	12
Cairo.	359	29.71	+.02	30.07	30.24	29.71	10.0.62	70.8	+.2	88.5	19	79.7	50.8	30	63.4	57.7	20.8	22	5.9	26	74.6	61.3	2.52	+	0.20	4.409	s.	30	n.	30	9	7	12	11
Springfield.	644	29.39	+.02	30.06	30.33	29.71	10.0.62	68.2	+.2	89.6	9	77.3	44.6	30	58.8	45.0	23.2	13	7.4	25	71.5	57.9	7.24	+	3.81	5.404	s.	24	s.	25	8	5	15	10
Saint Louis.	571	29.45	+.01	30.04	30.29	29.72	10.0.57	72.1	+.3	91.5	9	80.4	47.0	30	64.0	44.1	26.9	22	8.7	25	61.2	57.1	9.60	+	0.39	7.842	s.	40	w.	16	11	4	16	10
Missouri Valley.																																		
Lamar.	1,028	28.99	-.02	29.95	30.32	29.70	15.0.62	69.9	-.3	91.3	7	81.9	42.5	30	60.3	48.8	28.6	29	11.3	24	71.9	58.9	5.96	+	0.80	6.471	s.	28	sw.	16	9	5	13	12
Leavenworth.	842	29.11	-.02	29.98	30.27	29.60	15.0.67	70.5	+.3	96.8	7	83.4	40.9	30	61.0	55.9	39.0	18	11.7	25	66.8	57.5	2.75	+	1.89	5.436	s.	22	nw.	16	7	5	13	12
Omaha.	1,113	28.83	-.01	29.98	30.30	29.57	15.0.73	65.3	+.3	92.7	22	77.9	39.9	30	55.8	52.8	34.0	29	10.1	25	69.7	53.8	4.45	+	1.89	5.534	s.	24	nw.	16	19	7	16	7
Valentine.	2,603	27.28	-.02	29.95	30.32	29.46	14.0.86	59.6	-.3	93.4	23	74.0	37.4	28	47.1	58.7	46.3	21	8.6	1	56.6	41.0	1.18	+	0.32	8.551	nw.	42	nw.	9	7	4	11	15
Huron.	1,307	28.55	-.02	29.94	30.31	29.39	14.0.91	58.7	+.2	91.9	23	73.8	27.9	30	46.2	67.0	44.0	14	11.6	1	63.7	44.1	1.59	+	0.32	9.955	nw.	34	se.	14	10	5	15	10
Yankton.	1,334	28.63	-.04	29.93	30.26	29.43	14.0.82	61.9	+.6	91.7	23	74.4	33.9	30	52.3	57.8	38.6	29	7.0	18	70.6	50.6	3.45	+	0.50	6.184	s.	32	s.	15	11	6	10	14
Northern slope.																																		
Fort Assinaboine.	2,690	27.16	+.02	29.98	30.29	29.50	25.0.76	53.4	-.5	84.6	1	66.6	31.5	6	41.6	53.1	42.2	1	10.4	16	56.7	36.8	1.47	+	0.18	7.648	sw.	41	w.	23	5	9	11	10
Fort Benton.	2,661	27.16	+.02	29.98	30.29	29.50	25.0.76	53.4	-.5	84.6	1	66.6	31.5	6	41.6	53.1	42.2	1	10.4	16	56.7	36.8	1.47	+	0.18	7.648	sw.	41	w.	23	5	9	11	10
Fort Custer.	3,040	26.84	+.02	29.97	30.34	29.50	25.0.84	56.0	-.6	89.0	3	72.7	30.0	29	40.9	59.0	50.4	22	11.5	16	60.7	40.2	0.66	+	0.08	4.715	n.	31	n.	14	6	5	9	15
Fort Maginnis.	4,340	25.58	+.02	29.97	30.30	29.50	14.0.80	51.0	-.1	82.9	2	64.8	27.1	6	40.1	55.8	34.7	18	11.4	20	56.0	34.4	1.17	+	0.48	7.192	nw.	46	nw.	25	5	3	14	13
Fort Shaw.	3,550	26.36	+.02	29.98	30.35	29.50	25.0.85	52.8	-.2	82.4	13	68.4	32.3	6	41.4	50.1	41.5	13	10.7	16	61.0	38.5	1.10	+	0.42	2.195	w.	30	ne.	6	5	4	11	15
Helena.	4,009	25.86	+.02	29.98	30.37	29.59	25.0.78	52.9	-.3	81.8	1	65.7	31.4	5	42.0	50.4	34.0	1	8.8	3	56.0	36.0	2.40	+	0.89	5.342	sw.	30	sw.	26	7	6	9	15
Poplar River.	2,030	27.82	+.02	29.93	30.29	29.46	14.0.83	53.1	-.3	85.6	1	69.9	17.0	30	36.3	68.6	49.5	21	18.1	17	66.6	40.9	0.21	+	0.44	7.196	w.	48	w.	9	4	1	19	10
Deadwood.	4,600	25.41	+.02	29.93	30.39	29.60	23.0.79	53.7	+.1	83.2	23	65.3	35.3	17	44.8	47.9	32.0	21	10.0	27	64.7	41.2	1.06	+	0.25	1.610	sw.	18	s.	23	5	2	9	19
Cheyenne.	6,105	25.41	+.02	29.93	30.39	29.60	23.0.79	53.7	+.1	83.2	23	65.3	35.3	17	44.8	47.9	32.0	21	10.0	27	64.7	41.2	1.06	+	0.25	1.610	sw.	18	s.	23	5	2	9	19
North Platte.	2,841	27.07	-.01	29.97	30.38	29.52	15.0.86	61.6	-.2	91.0	22	74.6	58.0	16	50.4	53.0	43.4	22	7.4	7	66.2	48.2	1.22	+	0.13	5.826	n.	32	s.	5	3	1	9	20
Middle slope.																																		
Denver.	5,294	24.77	-.01	29.92	30.44	29.45	15.0.99	60.4	-.7	85.7	21	75.1	29.0	28	45.6	56.7	44.5	29	10.1	7	52.8	39.6	0.98	+	0.06	4.658	s.	36	n.	24	4	1	11	18
Pike's Peak.	14,134	17.96	-.01	29.96	30.27	29.62	15.0.65	32.0	+.5	44.0	19	40.5	21.0	27	27.5	53.0	23.1	9	7.6	1	78.1	26.4	0.71	+	1.15	11.672	w.	64	w.	17	6	0	10	20
West Las Animas.	3,899	26.05	-.01	29.90	30.41	29.47	15.0.93	61.7	-.3	93.8	18	82.4	33.1	28	46.7	40.3	24.6	18	13.1	27	61.8	48.7	1.23	+	0.63	4.158	s.	36	n.	27	4	4	10	16
Concordia.	1,384	28.53	-.01	29.96	30.34	29.49	15.0.84	68.7	+.2	93.2	22	81.0	39.4	29	57.9	53.9	38.2	29	9.7	25	68.6	57.1	3.8	+	1.04	6.218	s.	29	n.	27	4	4	9	17
Dodge City.	2,523	27.42	-.01	29.96	30.44	29.49	15.0.84	68.7	+.2	93.2	22	81.0	39.4	29	57.9	53.9	38.2	29	9.7	25	68.6	57.1	3.8	+	1.04	6.218	s.	29	n.	27	4	4	9	17
Fort Reno.	2,700	27.42	-.01	29.96	30.44	29.49	15.0.84	68.7	+.2	93.2	22	81.0	39.4	29	57.9	53.9	38.2	29	9.7	25	68.6	57.1	3.8	+	1.04	6.218	s.	29	n.	27	4	4	9	17
Fort Supply.	2,700	27.42	-.01	29.96	30.44	29.49	15.0.84	68.7	+.2	93.2	22	81.0	39.4	29	57.9	53.9	38.2	29	9.7	25	68.6	57.1	3.8	+	1.04	6.218	s.	29	n.	27	4	4	9	17
Fort Elliott.	2,700	27.42	-.01	29.96	30.44	29.49	15.0.84	68.7	+.2	93.2	22	81.0	39.4	29	57.9	53.9	38.2	29	9.7	25	68.6	57.1	3.8											

Office, however, were also very low, and on the afternoon negative values were given. This occurred during cloudy, threatening weather.

At Boston, Massachusetts, a complete and valuable set of observations were made during the month of September. The greatest value obtained was at 3 p. m. of the 2d, equivalent to 640 volts, on a clear, cool day characterized by high barometric readings. The lowest occurred on the 18th, at 3 p. m., 316 volts on the negative side, just in advance of a thunder-storm, with a second minimum on the 10th at 11 a. m., of 9.6 volts on the negative side, during an interval of no rain in a rainy spell. Negative values were obtained as follows: on 10th, at 11 a. m., rain began at midnight and continued the whole day; on 18th, at 3 p. m., preceding thunder-storm at 3.15 p. m. The values at the 1 and 3 p. m. observations were respectively, positive, 515, negative, 316 volts. On the 25th, at 3 p. m., a feeble negative indication, the weather being threatening.

Rain occurred, in addition to the dates mentioned, on the 16th, previous to earliest observation, from 10.30 a. m. until 3.45 p. m., and on the 17th early in the morning; all day on the 23d and 28th. The rain of the 16th was accompanied by variable, high, positive values, the highest values occurring at those observations preceding the ending of the rain. The rain on the 23d was accompanied by rather low positive indications, although indications as low are noted at times during the clear weather preceding and following. The observations for the month are charted on the second diagram of chart vi.

At Columbus, Ohio, negative indications were recorded in the observations taken on the 22d, at 3 p. m., rain commencing at 6.40 p. m., and on the 23d at 1 p. m., very feeble. A thunder-storm occurred during the night of the 23d. On the 27th feeble negative indications were noted during rain.

At Ithaca, New York, a complete and interesting set of observations was recorded. Negative indications occur on August 30th, at the 11 o'clock observation, rain beginning at 2.40 p. m.; on September 12th, at three of the four observations, rain occurring throughout the day; on September 14th, at 9 a. m., rain beginning at 9.05 a. m.; on September 16th, during showery weather, and on September 26th, at 9 a. m., during light rain. Rain occurred upon other dates than those mentioned, as follows: on September 9th, in the evening; on September 17th, late in the afternoon; on the 19th, ending at 9 a. m., and during the nights of the 26th and 27th. Thunder-storms occurred during the night of the 18th, during the afternoon of the 19th, and during the nights of the 22d, 23d, 26th, and 27th.

At New Haven, Connecticut, during the last third of the month negative indications are not noted. Rain occurs but once, at 9.08 a. m., September 23d, and is accompanied by the highest noted positive potential.

#### OPTICAL PHENOMENA.

##### SOLAR HALOS.

Solar halos were observed in the various states and territories, as follows:

- Alabama*.—Mobile, 24th.
- Colorado*.—Montrose, 10th; West Las Animas, 10th, 12th.
- Connecticut*.—New London, 14th.
- Dakota*.—Webster, 10th.
- Florida*.—Archer, 6th, 7th, 17th, 18th; Key West, 7th, 24th.
- Georgia*.—Savannah, 16th.
- Illinois*.—Riley, 3d, 7th; Springfield, 6th, 24th; Pekin, 6th, 29th; Charleston, 18th, 21st; Anna, 30th.
- Indiana*.—Vevay and Jefferson, 1st; Sunman, 13th, 21st, 30th; Greencastle, 18th.
- Iowa*.—Cedar Rapids, 10th, 28th, 29th.
- Kansas*.—Yates Centre, 5th, 10th, 13th; Salina, 9th; Wyandotte, 7th, 14th; Westmoreland, 12th.
- Kentucky*.—Frankfort, 22d; Richmond, 30th.
- Maine*.—Cornish, 22d.
- Massachusetts*.—Somerset, 14th; Blue Hill Observatory, 14th, 26th; Milton, 26th.

*Michigan*.—Port Huron, 4th; Mottville, 15th, 18th; Marquette, 25th.

*Minnesota*.—Duluth, 18th, 20th; Moorhead, 20th.

*Missouri*.—Centreville, 24th, 30th.

*New Jersey*.—Clayton, 2d, 14th, 24th; Sandy Hook, 4th; Dover, 4th, 14th; Moorestown, 14th; Beverly, 29th.

*New York*.—Factoryville, Palmyra, and North Volney, 4th; Oswego, 4th, 15th, 22d; Buffalo, 10th, 15th; Albany, 22d.

*North Carolina*.—New River Inlet, 1st, 5th, 12th, 18th; Weldon, 12th.

*Ohio*.—Wauseon, 1st, 2d, 13th, 14th, 15th, 18th, 23d; Toledo, 18th; Tiffin, 21st.

*Oregon*.—East Portland, 22d.

*Pennsylvania*.—Dyberry and Wellsborough, 4th; Grampian Hills, 14th; East Brook, 30th.

*South Carolina*.—Spartanburg, 11th, 12th.

*Tennessee*.—Chattanooga, 19th; Nashville, 30th.

*Vermont*.—Lunenburg, 20th.

*Virginia*.—Lynchburg, 4th, 11th, 26th; Wytheville, 10th; Dale Enterprise, 8th, 9th, 12th, 13th, 14th, 23d, 29th; Variety Mills, 14th, 25th; Rappahannock, 20th.

*Washington Territory*.—Port Angeles, 4th.

*Wisconsin*.—Delavan, 3d.

*Wyoming*.—Fort Bridger, 1st, 28th.

##### LUNAR HALOS.

Lunar halos were observed in the various states and territories, as follows:

- Alabama*.—Mobile, 8th, 11th, 13th, 19th.
- California*.—San Diego, 9th.
- Colorado*.—Pike's Peak, 8th, 12th; Montrose, 10th; West Las Animas, 10th, 12th.
- Connecticut*.—New Haven, 11th, 13th; New London, 13th.
- Delaware*.—Cape Henlopen, 16th.
- District of Columbia*.—Washington City, 11th to 14th.
- Florida*.—Key West, 6th, 8th, 9th, 10th; Pensacola, 6th, 8th, 11th; Limona, 6th, 9th, 10th, 11th, 14th; Cedar Keys, 6th, 10th, 11th, 12th, 15th, 16th; Alva, 8th; Manatee and Alva, 10th; Sanford, 14th.
- Georgia*.—Savannah, 7th, 9th; Atlanta, 12th, 13th.
- Illinois*.—Pekin, 2d, 5th, 6th, 8th; Windsor, 5th; Springfield, 6th, 7th, 8th; Anna, 8th, 10th, 14th; Cairo, 12th; Riley, 16th.
- Indiana*.—Lafayette, 5th; Fort Wayne, 11th; Jeffersonville and Sunman, 12th; Vevay, 22d.
- Iowa*.—Independence, 14th.
- Kansas*.—Salina, 4th, 9th; Yates Centre, 7th, 14th; Wyandotte, 10th, 12th.
- Kentucky*.—Frankfort, 12th, 13th; Richmond and Louisville, 13th.
- Louisiana*.—New Orleans, 8th, 12th.
- Maine*.—Portland, 14th.
- Massachusetts*.—Somerset, 13th, 14th; Milton and Blue Hill Observatory, 13th, 14th, 15th; Princeton, 14th.
- Michigan*.—Escanaba, 8th, 21st.
- Missouri*.—Saint Louis, 9th; Lamar, 12th, 13th.
- Nebraska*.—De Soto, 5th; Hay Springs, 7th; North Platte, 10th, 11th.
- New Jersey*.—Beverly, 5th, 6th, 8th, 9th, 13th; Egg Harbor City, 5th, 13th; Atlantic City and Clayton, 13th.
- New York*.—Oswego, North Volney, and Palermo, 4th; New York City, 5th, 13th, 16th; Ithaca, 11th, 14th; Rochester, 12th; Le Roy, 12th; Setauket, 13th, 14th; Humphrey, 23d.
- North Carolina*.—Wilmington, 6th, 13th, 15th; New River Inlet, 8th; Charlotte, 13th; Smithville, 14th.
- Ohio*.—Napoleon, 4th, 9th, 11th; Columbus, 9th, 13th; Wauseon, Toledo, Cleveland, and Elyria, 11th; Cincinnati, 13th; Jacksonborough, 14th.
- Rhode Island*.—Block Island, 13th.
- South Carolina*.—Spartanburg, 12th, 13th.
- Tennessee*.—Milan, 5th; Knoxville and Memphis, 12th.
- Texas*.—Brownsville, 5th; Rio Grande City, 6th; Galveston, 6th, 11th, 12th; El Paso, 7th; Palestine, 13th.



*Virginia*.—Dale Enterprise, 7th, 8th, 9th, 11th, 13th; Rappahannock, 7th, 9th, 11th, 13th; Lynchburg, 9th, 10th, 12th; Chincoteague, 13th; Bird's Nest, 13th, 14th.

*West Virginia*.—Helvetia and Parkersburg, 13th.

*Wisconsin*.—Milwaukee, 6th, 11th, 16th; Green Bay and Embarras, 8th; Madison, 11th.

*Wyoming*.—Cheyenne, 14th.

The phases of the moon (Washington mean time) during September, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 27th, 4 h. 10.4 m.; first quarter, 4th, 14 h. 47.3 m.; full moon, 12th, 17 h. 42.1 m.; last quarter, 20th, 12 h. 47.6 m.; apogee, 10th, 22.3 h.; perigee, 26th, 1.9 h.

#### MIRAGE.

Maricopa, Arizona: on the morning of the 15th a mirage was seen to the eastward of the station. The mountains were changed into fantastic shapes, resembling houses, ships, etc. Mirage was observed at other stations, as follows:

Salina, Kansas, 10th, 28th, 30th.

Tecumseh, Nebraska, 30th.

#### MISCELLANEOUS PHENOMENA.

##### DROUGHT.

Albany, New York, 9th: the rainfall of the past month has been very small and the drought is becoming severe in this vicinity; many wells are drying, and cattle are suffering from want of sufficient pasturage. The water in the river is low and navigation is nearly suspended.

Tolono, Champaign county, Illinois: the drought which has prevailed here since June was partially broken on the 17th by a heavy rain.

Fort Worth, Texas, 25th: reliable information from the drought-affected region of Texas shows that newspaper accounts have been only slightly exaggerated. The drought extends over the whole of the northwestern portion of the state, from Fort Worth up into the region commonly called the Panhandle. This was a fine grazing country and a large amount of stock is kept here. This year it has been impossible to supply the stock with water, and thousands have perished. People have been obliged to transport water many miles for household purposes. In some parts of this district no heavy rains have fallen during the past fourteen months, and, as a consequence, many of the smaller streams have become exhausted and wells and cisterns are dry.

Boisé City, Idaho: the total rainfall from July 4th until September 30th is only .01 inch. Since the land under cultivation in the valleys is irrigated, the damage here by drought is not great, but the cattle ranges on the mountains and hills are suffering severely from the dry weather.

##### EARTHQUAKES.

During September many light earthquake shocks were felt in the Southern States, especially from the 1st to the 7th, and on the 21st and 27th. The observers at Pacolet and Kirkwood, South Carolina, state that earthquake shocks were felt nearly every day during the month. The shock of the 3d, at 11.01 p. m., was quite severe at Charleston, South Carolina, and created much excitement. In Augusta, Georgia, at the same time, a sudden motion of the earth was felt of about four seconds' duration, with a jerking motion from southeast to northwest. At Savannah slight shocks were felt at intervals during the 3d, and at 10.50 p. m. a very distinct motion occurred; it was preceded by a rumbling noise, and was accompanied by quick vibrations, which continued fifteen or twenty seconds. This shock was more severe than any felt since that of August 31st. Although no damage was done to buildings or other property, the shock caused much alarm, and many persons left their houses and again passed the night in the open air. The shocks of the 21st and 27th were of sufficient intensity in Charleston, Augusta, and Savannah to rattle windows and cause pictures and chandeliers to sway back and forth, and were accompanied by a low rumbling sound.

The following record of earthquake data for September, 1886, giving the place, day, hour, and, when the information could be obtained, the duration of the shocks, is compiled from the reports of the regular and voluntary observers of the Signal Service:

*Florida*.—Cedar Keys: 2d, 11.10 p. m.; 3d, 4 p. m.

Jacksonville: 1st, 4 and 4.30 a. m.; 8th, 1.34 p. m.; 9th, 1.47 p. m.

Sanford: 3d, 11.03 p. m., duration five seconds; 5th, 11.10 p. m., duration two seconds.

Archer: 22d, 10 p. m., duration three seconds.

*Georgia*.—Savannah: 1st, 12.45 a. m.; 1.11 a. m.; 3.44 a. m.; 8.35 a. m., duration three seconds; 2.43 p. m.; 5.12 p. m., duration six seconds; 5.50 p. m.; 11.54 p. m. 2d, 2.10 a. m., duration four seconds; 3.10 a. m., tremors at intervals during the day, accompanied by low, rumbling sound. 3d, 10.50 p. m., duration seventeen seconds, accompanied by rumbling sound. 4th, 3.45 a. m.; 4.22 a. m.; 11.26 a. m.; 3.09 p. m.; 3.18 p. m.; 9.30 p. m., duration four seconds, accompanied by low, rumbling sound; tremors during the night. 5th, 11.16 a. m.; 1.13 p. m.; 8.45 p. m.; 11.07 p. m., accompanied by sound, rattled windows. 6th, 8.37 a. m., tremors during the morning; 4.03 p. m., duration two seconds. 7th, 5.04 p. m., duration two seconds. 8th, 11.15 a. m., duration three seconds; 11.24 p. m. 11th, 2.32 p. m., duration four seconds. 21st, 5.20 a. m., duration twelve seconds, accompanied by rumbling sound, windows rattled. 27th, 5 p. m., duration four seconds.

Augusta: 1st, 4.35 a. m.; 8.10 a. m.; 5.14 p. m.; 11.28 p. m. 3d, 11 p. m., duration four seconds. 4th, 7.03 a. m.; 9.41 p. m.; 11.10 p. m. 5th, 11.05 p. m. 21st, 5.23 a. m., duration four seconds, windows rattled.

Atlanta: 3d, 11.05 p. m.

Athens: 1st, 4 p. m.; 10.45 p. m., duration one second. 3d, 10.10 p. m., duration twenty-five seconds. 4th, 8.35 p. m., duration twenty seconds.

Forsyth: 1st, 8 a. m.; 3d, 10 p. m.

*North Carolina*.—Charlotte: 1st, 1.04 a. m.; 5.19 p. m.; 10.03 p. m.; 11.10 p. m. 2d, 1.07 a. m.; 3d, 11.07 p. m. 4th, 11.45 a. m.; 10.03 p. m. 5th, 5.25 p. m., caused plaster to fall from ceilings. 7th, 5.04 p. m. 9th, 10.19 a. m. 27th, 5.03 p. m.

Smithville: 1st, 1.10 a. m., duration six seconds; 5 a. m., duration five seconds; 8.30 a. m., duration four seconds; 5.13 p. m., duration eight seconds; 8.40 p. m., duration three seconds; 11.55 p. m., duration three seconds. 3d, 11.02 p. m., duration ten seconds, rattled doors and windows. 5th, 9.04 p. m., duration four seconds.

Wilmington: 1st, 1.10 a. m.; 5 a. m.; 8.30 a. m.; 5.13 p. m.; 8.40 p. m.; 11.55 p. m., these shocks were from three to six seconds in duration. 3d, 11.02 p. m., duration ten seconds, preceded by rumbling sound, caused plaster to fall from ceilings. 4th, 11.03 p. m., duration five seconds. 5th, 9.05 p. m., duration five seconds; 11 p. m., duration five seconds.

Chapel Hill: 3d, 11.05 p. m., duration nearly one minute.

Lenoir: 1st, 5 p. m.; 3d, 10 p. m.

Lincolnton: 3d, 11.05 p. m.

Statesville: 1st, 9.10 a. m.; 4.45 p. m.; 11 p. m. 3d, 10.55 p. m. 6th, 9 p. m. 26th, 8 p. m.

Weldon: 3d, 11.03 p. m.

*South Carolina*.—Charleston: 1st, 1.02 a. m.; 8.25 a. m.; 9.59 a. m.; 5.16 p. m.; 5.52 p. m.; 11.55 p. m. 2d, 11.53 p. m. 3d, 11.01 p. m. 5th, 11.06 p. m., caused plaster to fall from walls. 7th, 4.52 p. m. 8th, 12.55 p. m. 9th, 1.06 a. m., accompanied by a heavy, rumbling sound. 27th, 2.02 p. m., duration two seconds; caused loose plaster and bricks to fall. 28th, 1.00 p. m. Spartanburg: 1st, 2 a. m.; 5 a. m.; 8 a. m.; 2 p. m.; 4.10 p. m. 2d, 2 a. m.; 4.10 p. m. 3d, 4 a. m.; 4.10 p. m. 4th, 11 p. m.; duration three seconds. 5th, 11 p. m. 7th, 4 a. m.; 4.30 p. m.; tremors during the night. 22d, 4 a. m. 27th, 4 a. m. 28th, 3 a. m.

*Tennessee*.—Chattanooga: 1st, several light shocks.

*Virginia*.—Lynchburg: 3d, 11.10 p. m., duration four seconds.

Norfolk: 3d, 11.02 p. m., duration seven seconds.

University of Virginia: 1st, 10 p. m.

Wytheville: 3d, 11 p. m., duration five seconds; 12 midnight. 24th, 9.56 p. m., duration twenty-five seconds; 10.10 p. m., duration nineteen seconds.

The following is an extract from the "New York Sun" of September 6, 1886:

ATHENS, September 5th.—Renewed earth shocks have been felt at Pyrgos, in Morea.

The following extracts are from the "New York Herald":

CITY OF MEXICO, September 12, 1886.—An official report to the government from Tequisitlan, a state of Mexico, says a shock of earthquake, with oscillations from east to west, was felt there between four and five o'clock on the morning of the 3d instant.

CONSTANTINOPLE, September 26, 1886.—Sharp shocks of earthquake were felt here and at Smyrna to-day. Slight damage was done.

HAVANA, September 28, 1886.—A sharp shock of earthquake was experienced in Saint Thomas on the 20th instant.

##### FOREST AND PRAIRIE FIRES.

Grand Rapids, Itasca county, Minnesota, 6th: miles of forest to the north of this town are burning, and millions of feet of valuable pine timber have been destroyed.

Calais, Washington county, Maine, 8th: forest fires are burning rapidly in the surrounding country. The water in rivers and lakes has not been so low for years. On account of the low water many saw-mills have been obliged to cease operations.

Fort Bridger, Wyoming, 27th: destructive forest fires are reported to be burning in the Yellowstone National Park.

Boise City, Idaho, 30th: the dry weather which has prevailed here during the latter part of the summer has been attended by an unusually large number of forest fires in the mountains, the smoke from which has continually pervaded the atmosphere of the valleys since early in August.

Christmas Prairie, Humboldt county, California: forest fires prevailed throughout this county from the 6th to the 30th, burning over numerous ranches. In some instances houses, barns, and fences were destroyed. From the 6th to the 18th the smoke was very dense, especially at night.

Forest and prairie fires have also been reported from the following places:

Fort Buford, Dakota: prairie fires, 3d, 4th.

Huron, Dakota: prairie fires, 6th.

Keeler, California: prairie fires, 15th.

Saint Vincent, Minnesota: prairie fires, 22d, 28th.

Walla Walla, Washington Territory: forest fires, 2d, 15th.

Cape Mendocino, California: forest fires, 8th.

Mount Angel, Oregon: forest fires, 10th.

#### INSECTS.

Oswego, New York, 20th: the hop crop of New York state, which is now being gathered, is almost a complete failure; the yield of 1886 is of very inferior quality and will be only about one-third the average crop. This loss of two-thirds is caused by the "hop louse," which made its appearance early in August, and multiplied rapidly.

Galveston, Texas, 26th: the recent heavy rains throughout the cotton belt have done considerable damage to open cotton. Since the rains set in cotton worms have multiplied rapidly, and are destroying the late bolls.

Salina, Saline county, Kansas: the warm and dry weather of the month has been favorable to the increase of chinch bugs; these insects have already done considerable damage to fall wheat.

#### METEORS.

Fall River, Massachusetts: on the 6th, at 8.15 p. m., a bright meteor was seen north of the zenith, moving toward the west; it was about the size of a cocoanut, and burst into fragments of various colors.

Albany, New York: at 8.30 p. m. of the 6th a large meteor, followed by a train of white light, was seen to pass across the sky in a northeasterly direction. The meteor burst when within ten degrees of the northern horizon.

The following description of this meteor is from the September bulletin of "The New England Meteorological Society":

A brilliant meteor was seen on the 6th, about 8.15 p. m., records of it coming from many stations as far separated as Berlin Mills, New Hampshire, on the north, Hartford, Connecticut, on the southwest, and Plymouth, Massachusetts, on the southeast. The sound of its explosion was heard at several points in central New Hampshire; at Epsom it made a rumbling sound; at Meredith Centre the report was equal to that of a cannon; at Wolfborough Junction and Contoocook it made a roaring sound, heavy rather than sharp, accompanied by a trembling that was thought by some to be an earthquake. Estimates of angular altitude made at Manchester and Nashua, New Hampshire, Newburyport, Massachusetts, and Hartford, Connecticut, indicate an altitude of about thirty miles at the time of exposition. At Princeton, Massachusetts, it seemed "near by," but was probably sixty or seventy miles away.

Syracuse, New York: on the 7th, at 8.35 p. m., a large yellow meteor was seen passing from the northwest toward the southeast at an altitude of about 30° from the horizon. Its diameter was equal to half the apparent diameter of the moon. Another large meteor, diameter about four inches, was seen on the 9th, at 9.30 p. m. It moved in a northerly direction and was followed by a train of light five feet in length.

Rochester, New York: at 10.15 p. m. of the 14th a meteor

was observed at an altitude of about 45°, passing in a direction a little north of east; it disappeared when about 25° above the horizon.

Winnemucca, Nevada: at 4.30 a. m. of the 17th a meteor was observed passing from east to west in a line parallel to the horizon, and of the apparent size and brilliancy of the planet Venus. Its elevation above the horizon was about five degrees and was visible through 30° of its course, its movement was comparatively slow, requiring three seconds to pass through a course of 30°.

Savannah, Georgia: a very brilliant meteor, of greenish tint, was observed at 9.30 p. m. of the 21st. It moved in an irregular course and disappeared near the northeastern horizon. Several smaller meteors were seen within the next hour, the last one, at 10.25 p. m., being of a whitish color and quite brilliant.

Chattanooga, Tennessee: at 8.53 p. m. of the 22d a large and bright meteor was seen falling from the northeast, taking a westerly course across the sky. The sky was illuminated by its light for nearly ten seconds.

Archer, Alachua county, Florida: at 7.37 p. m. of the 29th a brilliant meteor, accompanied by a hissing sound, was seen passing horizontally westward; its movement was comparatively slow, it being visible at least ten seconds.

Meteors were also observed in the various states and territories, as follows:

California.—Keeler, 22d, 29th.

Connecticut.—Voluntown, 30th.

Dakota.—Webster, 23d, 30th.

Florida.—Limona, 10th, 12th, 15th, 24th, 26th, 28th, 29th; Archer, 11th, 12th, 24th; Manatee, 15th, 23d to 28th.

Illinois.—Charleston, 22d.

Indiana.—Terre Haute, 18th.

Iowa.—Davenport, 4th, 22d, 23d, 24th; Monticello, 7th.

Kentucky.—Richmond, 22d.

Maine.—Bar Harbor, 8th.

Maryland.—Woodstock, 20th, 21st, 23d, 26th, 27th, 30th.

Massachusetts.—Amherst, 1st, 29th; Princeton, 6th; Dudley, 6th, 25th; Fall River, 18th.

Michigan.—Kalamazoo, 24th, 28th.

Nebraska.—Genoa, 21st, 22d, 30th.

New Hampshire.—Berlin Mills, 6th; Nashua, 6th, 18th.

New Jersey.—Beverly, 3d; Clayton, 20th; Dover, 22d, 26th; Egg Harbor City, 29th.

New York.—Syracuse, 9th; Albany, 9th, 13th; Setauket, 14th; Albany, 9th, 13th; North Volney, 17th, 30th.

North Carolina.—Smithville, 16th.

Ohio.—Cleveland and Tiffin, 11th; Jacksonborough, 11th, 28th.

Oregon.—East Portland, 26th.

Pennsylvania.—East Brook, 14th; Pittsburg, 20th.

South Carolina.—Charleston, 5th.

Texas.—Cleburne, 16th, 21st; Rio Grande City, 17th.

Vermont.—Brattleborough, 6th, 10th.

Virginia.—Rappahannock, 13th; Chincoteague, 17th, 19th; Dale Enterprise and Variety Mills, 21st; Wytheville, 29th.

#### MIGRATION OF BIRDS.

Geese flying southward.—Poplar River, Montana, 10th; Sacramento, California, 12th, 14th; Fort Buford, Dakota, 12th; San Diego, California, 13th; Red Bluff, California, 14th, 18th, 27th, 30th; Stockham, Nebraska, 15th; Allison, Kansas, 16th, 23d, 25th, 26th, 27th, 29th; Fall River, Massachusetts, 16th to 20th; Omaha, Nebraska, 19th; Bainbridge Island, Washington Territory, 23d; East Portland, Oregon, 24th; Port Angeles, Washington Territory, 26th; Saint Louis, Missouri, 26th; Kalamazoo, Michigan, 29th; Bancroft, Iowa, 30th.

Cranes flying southward.—Allison, Kansas, 16th, 23d, 25th, 26th, 27th, 29th.

Ducks flying southward.—Charleston, Illinois, 2d; Lamar, Missouri, 8th, 30th; Memphis, Tennessee, 20th; Merritt's Island, Florida, 20th; Bancroft, Iowa, 30th.



## POLAR BANDS.

Polar bands were reported from the following stations:

Napoleon, Ohio, 15th, 18th.  
Wauseon, Ohio, 1st, 15th.  
Fort Macon, North Carolina, 5th.  
Beverly, New Jersey, 13th.  
Memphis, Tennessee, 7th.  
Archer, Florida, 13th, 26th, 30th.  
Riley, Illinois, 2d, 11th, 18th.  
Salina, Kansas, 9th, 28th.  
Gardiner, Maine, 19th, 25th, 29th.  
Dale Enterprise, Virginia, 4th, 10th, 14th, 29th, 30th.  
Wytheville, Virginia, 10th, 13th, 20th.

## SAND STORMS.

Fort Custer, Montana, 14th, 26th.  
El Paso, Texas, 3d.  
Fort McDowell, Arizona, 11th, 20th.

## SUNSETS.

The characteristics of the sky, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from one hundred and fifty-seven stations show 4,669 observations to have been made, of which eight were reported doubtful; of the remainder, 4,661, there were 4,090, or 87.7 per cent., followed by the expected weather.

## SUN SPOTS.

Prof. David P. Todd, director of the Lawrence Observatory, Amherst, Massachusetts, furnishes the following record of sun spots for September, 1886:

Date— September, 1886. Standard time.	No. of new.		Disappeared by solar rotation.		Reappeared by solar rotation.		Total No. visible.		Remarks.
	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	
1, 7 a. m.	1	20 <sup>‡</sup>	0	0	0	0	1	20 <sup>‡</sup>	
3, 3 p. m.	1	25 <sup>‡</sup>	0	0	0	0	2	45 <sup>‡</sup>	
4, 4 p. m.	0	0	0	0	0	0	2	45 <sup>‡</sup>	
4, 5 p. m.	0	0	0	0	0	0	2	35 <sup>‡</sup>	
6, 6 p. m.	0	0	0	0	0	0	2	30 <sup>‡</sup>	
7, 9 a. m.	2	4	0	0	1	3	4	40 <sup>‡</sup>	
9, 9 a. m.	1	5	0	0	1	5	4	15 <sup>‡</sup>	
10, 4 p. m.	1	40 <sup>‡</sup>	0	5 <sup>‡</sup>	0	15 <sup>‡</sup>	5	55 <sup>‡</sup>	Broad areas of faculae.
11, 5 p. m.	1	2	1	3	0	0	3	35 <sup>‡</sup>	
13, 5 p. m.	2	15 <sup>‡</sup>	0	0	0	0	5	50 <sup>‡</sup>	
17, 5 p. m.	0	0	0	0	0	0	3	40 <sup>‡</sup>	Broad areas of faculae.
18, 11 a. m.	0	0	0	0	0	0	3	40 <sup>‡</sup>	
20, 10 a. m.	0	0	0	15 <sup>‡</sup>	0	0	3	25 <sup>‡</sup>	
22, 12 m.	1	10 <sup>‡</sup>	2	25 <sup>‡</sup>	0	0	1	10 <sup>‡</sup>	
24, 10 a. m.	0	0	0	0	0	0	1	3	
26, 11 a. m.	0	0	0	0	0	0	0	0	
29, 11 a. m.	1	3	0	0	1	3	1	3	
30, 1 p. m.	0	0	0	0	0	0	1	3	

Faculae were seen at the time of every observation.

<sup>‡</sup>Approximated.

Mr. H. D. Govey, of North Lewisburg, Champaign county, Ohio, reports having observed sun spots on the following dates: 2d, 4th, 6th to 11th, 13th, 14th, 15th, 17th, 18th, 20th, 21st, 30th.

## WATER-SPOUTS.

The bark "Elida" reports, September 23d, in latitude N. 38° 40', longitude W. 70° 10', passed close to a large water-spout.

Fourth Officer J. Niedermeyer, of the s. s. "Weser," Capt. H. Bruns, commanding, reports having observed a water-spout on the 23d, at 9.45 a. m., in N. 35° 56', W. 57° 2'.

## VERIFICATIONS.

## INDICATIONS.

The indications for September, 1886, were made by 2d Lieutenant Frank Greene, Signal Corps, U. S. Army, Assistant, and were verified by 2d Lieutenant J. E. Maxfield, Signal Corps, U. S. Army, Assistant.

The detailed comparison of the tri-daily indications for September, 1886, with the telegraphic reports for the succeeding thirty-two hours, shows the general average percentage of verifications to be 73.16. The percentages for the different elements are: Weather, 72.24; wind, 68.66; temperature, 75.44. By states, etc., the percentages are: For Maine, 69.36; New Hampshire, 69.03; Vermont, 65.03; Massachusetts, 66.44;

Rhode Island, 69.95; Connecticut, 67.78; New York, 73.11; Pennsylvania, 71.53; New Jersey, 72.56; Delaware, 70.81; Maryland, 74.44; District of Columbia, 72.81; Virginia, 71.72; North Carolina, 75.08; South Carolina, 76.22; Georgia, 82.11; Florida, 79.19; Alabama, 81.42; Mississippi, 77.77; Louisiana, 78.75; Texas, 76.91; Arkansas, 75.61; Tennessee, 76.19; Kentucky, 72.92; Ohio, 71.92; West Virginia, 70.69; Indiana, 73.47; Illinois, 69.72; Michigan, 71.28; Wisconsin, 63.58; Minnesota, 63.33; Iowa, 62.94; Kansas, 72.06; Nebraska, 62.94; Missouri, 75.42; Colorado, 68.50; east Dakota, 61.42.

There was one omission to predict, out of 9,630, or 0.01 per cent. Of the 9,629 predictions that have been made, eight hundred and one, or 8.32 per cent., are considered to have entirely failed; six hundred and seven-three, or 6.98 per cent., were one-fourth verified; 2,035, or 21.13 per cent., were one-half verified; 1,843, or 19.14 per cent., were three-fourths verified; 4,277, or 44.42 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

## CAUTIONARY SIGNALS.

During September, 1886, one hundred and forty-seven signals of various kinds were ordered, of which number, fifty-two, or 35.31 per cent., were fully justified both as to direction and velocity. Of the above signals, twenty-one were ordered for southwesterly winds; of these, ten, or 47.62 per cent., were justified both as to direction and velocity, and twelve, or 57.14 per cent., were justified as to velocity only. Twenty-three signals were ordered for northwest winds; of these, seven, or 30.44 per cent., were justified both as to direction and velocity. Ninety-eight signals were ordered for winds without regard to direction; of these, thirty-one, or 31.63 per cent., were justified. Five on-shore signals were ordered; of these, four, or 80.00 per cent., were justified.

In twenty-five cases winds occurred which would have justified cautionary signals had they been displayed, and in twenty-eight cases winds occurred which would have justified the display of on-shore signals.

## COLD-WAVE SIGNALS.

During September, 1886, twenty-seven cold-wave signals were ordered, of this number the verification of twenty-two was determined; of these, fifteen, or 68.18 per cent., were justified.

## RAILWAY WEATHER SIGNALS.

Prof. P. H. Mell, jr., director of the "Alabama Weather Service," in the report for September, 1886, states:

The verification of predictions for the whole area was 91 per cent. for temperature, and 87 per cent. for weather.

The following corporations comprise this system: South and North; Montgomery and Mobile; Mobile and Girard; Georgia Pacific; East Tennessee, Virginia and Georgia system in Alabama; Memphis and Charleston; Columbus and Western; Atlanta and West Point of Georgia; Northeastern of Georgia; Western and Atlantic; East Tennessee, Virginia and Georgia system in Georgia; Montgomery and Eufaula; Pensacola and Selma; Pensacola and Atlantic; the cities of Milledgeville, Georgia, and Talladega, Alabama.

## LOCAL WEATHER SIGNALS.

Prof. Goodwin D. Swezey, director of the "Nebraska Weather Service," in the report for September, 1886, makes the percentage of verifications for temperature in the state 83.0, and weather 81.9.

Prof. Winslow Upton, director of the "New England Meteorological Society," in the report for September, 1886, states:

The verification of weather signals at New Haven was 90 per cent. for temperature, 83 for weather; at eight stations reporting at the signal office in Boston, 90 for temperature, 80 for weather. Local sunset predictions at Blue Hill for twenty-four hours from midnight were verified, 80 per cent; prediction at 8 a. m., for sixteen hours 83 per cent; the Signal Service indications had a local verification of 63 per cent.

## ERRATA.

In the REVIEW for August, 1886, on page 225, under "Tornado studies," the words "geographical mile," wherever they occur, should read "geographical degree." On page 235, in the table "Summary of report from observers—Earthquake of August 31, 1886," "Hollow (?) Springs, Tennessee, observer, N. F. Bryant," should read "Holly Springs, Mississippi, observer, N. T. Bryant."

*Meteorological record of voluntary observers and Army post surgeons, September, 1886.*

The maximum and minimum temperatures at stations marked thus (\*) are from readings of other than standard instruments.

Stations.	Temperature.				Stations.	Temperature.			
	Maximum.	Minimum.	Mean.	Rainfall.		Maximum.	Minimum.	Mean.	Rainfall.
<i>Alabama.</i>					<i>Iowa.</i>				
Greensborough.....	89	56	77.7	0.54	Bancroft.....	90	32	60.6	5.03
Livingston.....	91	57	78.5	0.68	Cedar Rapids.....	90	30	64.1	2.86
Mount Vernon B'ks.....	92	51	76.8	0.76	Clinton.....	95	32	63.9	3.89
<i>Arizona.</i>					Des Moines.....	95	37	65.9	
Huachuca, Fort.....	92	48	66.9	1.46	Fort Madison.....	91	37	64.5	3.45
Lowell, Fort.....	92	49	81.1	1.04	Independence.....	94	30	62.0	4.98
McDowell, Fort.....	109	54	84.4	trace	Logan.....	92	37	63.5	6.76
Tucson.....				3.47	Manchester.....	93	33	63.0	2.80
<i>Arkansas.</i>					Monticello.....	92	39	66.0	
Lead Hill.....	102	47	74.3	8.44	Mount Vernon.....	95	34	66.4	3.05
<i>California.</i>					Muscataine.....	90	40	68.0	5.29
Alcatraz Island.....	89	49	56.8	0.02	Oskaloosa.....	91	43	67.3	4.41
Angel Island.....	104	51	66.8	0.00	<i>Kansas.</i>				
Benicia Barracks.....	96	54	62.7	trace	Allison.....	104	30	67.3	1.18
Bigwell, Fort.....	88	33	62.7	0.00	Atchison.....	98	42	71.1	3.07
Blue Lake.....	98	37	59.6	0.00	Belleville.....	93	38	73.6	4.10
Cahuenga.....				0.00	Elk Falls.....	91	41	67.0	0.90
Gaston, Fort.....	104	30	66.5	0.00	Emporia.....	96	43	66.8	3.06
Hydesville.....				0.00	Hays, Fort.....	92	46	71.4	3.37
Mason, Fort.....	85	53	61.0	0.00	Independence.....	94	44	71.2	2.34
Nicolaus.....	99	54	72.2	0.05	Lawrence.....	98	37	70.7	1.18
Oakland.....	91	50	61.1	0.00	Manhattan.....	98	37	76.4	1.14
Oroville.....	96	54	74.2	0.00	Riley, Fort.....	99	39	72.4	0.32
Poway.....	99	58	67.7	trace	Salina.....	94	51	73.4	1.03
Presidio of San F.....	94	46	59.4	0.00	Sterling.....	94	39	67.5	0.90
Princeton.....	102	41	73.1	0.00	Topeka.....	101	44	72.8	1.82
Sacramento.....	91	44	65.9	0.00	West Leavenworth.....	99	43	71.0	2.75
Salinas.....	88	46	65.5	0.00	Wyandotte.....	98	41	70.4	2.50
Santa Barbara.....	79	48	63.8		Wellington.....	95	38	71.3	2.76
<i>Colorado.</i>					Yates Centre.....	93	40	69.8	3.85
Colorado Springs.....	84	28	59.4	0.33	<i>Kentucky.</i>				
Lewis, Fort.....	77	32	55.0	1.02	Bowling Green.....	91	45	69.2	1.75
<i>Connecticut.</i>					Frankfort.....	94	42	69.2	2.90
Hartford.....	86	34	60.4	3.08	Richmond.....	86	44	68.4	2.07
North Colerbrook.....	82	32	58.6	1.58	<i>Louisiana.</i>				
Voluntown.....	86	35	60.0	2.10	Grand Coteau.....	90	55	78.3	5.91
<i>Delaware.</i>					Liberty Hill.....	88	60	81.8	5.42
Abr. Lincoln, Fort.....	95	31	55.5	0.38	Luling.....	90	58	76.8	3.83
Meade, Fort.....	94	23	58.8	0.40	<i>Maine.</i>				
Pembina, Fort.....	98	12	51.2	3.90	Bar Harbor.....	82	37	58.0	2.58
Randall, Fort.....	98	23	63.6	4.05	Cornish.....	86	35	56.8	4.95
Shenandoah, Fort.....	94	17	50.2	0.78	Gardiner.....	80	35	57.9	3.68
Sully, Fort.....	101	30	62.0	0.30	Kent's Hill.....	84	32	56.2	3.59
Totten, Fort.....	85	19	52.7	0.34	Orono.....	88	31	56.2	4.11
Webster.....	97	16	58.8	1.71	<i>Maryland.</i>				
Yates, Fort.....	95	20	56.6	0.72	Cumberland.....	88	44	65.4	1.33
<i>District of Columbia.</i>					Fallston.....	90	40	67.1	1.03
Distributing Res'rs.....	88	50	71.2	2.07	Great Falls.....	92	44	68.9	1.04
Receiving Res'rs.....	90	52	71.3	2.04	McDonogh.....	86	47	67.9	3.30
Rock Creek Bridge.....	93	52	73.1		McHenry, Fort.....	85	54	69.2	1.22
<i>Florida.</i>					Woodstock.....	88	43	66.0	1.61
Archer.....	92	68	82.2	3.05	<i>Massachusetts.</i>				
Alva.....	93	76	76.6	8.90	Amherst.....	84	32	59.5	5.48
Meade, Fort.....				5.40	Amherst.....	85	38	60.6	3.68
Limona.....	90	71	81.6	4.22	Blue Hill Ob'y.....	86	38	60.2	5.08
Manatee.....	93	76	79.8	0.22	Deerfield.....	82	34	59.8	5.20
Merritt's Island.....	92	70	78.8	3.53	Dudley.....	83	50	63.3	2.23
St. Augustine, Fort.....	88	64	76.8	4.65	Fall River.....	80	40	63.3	2.80
<i>Georgia.</i>					Milton.....	82	36	58.7	2.17
Athens.....	88	57	73.1	0.96	New Bedford.....	79	38	62.9	2.47
Forsyth.....	94	39	76.6	0.10	Princeton.....	81	35	66.4	3.93
Milledgeville.....	91	68	77.3	0.59	Somerset.....	80	38	66.4	2.62
<i>Idaho.</i>					Taunton.....	87	35	62.8	2.76
Boise Barracks.....	92	29	63.6	0.00	Westborough.....	87	32	63.0	4.31
Coeur d'Alene, Fort.....	83	28	56.3	0.79	Williamstown.....	83	35	59.9	4.31
<i>Illinois.</i>					Worcester.....	77	40	58.7	3.53
Anna.....	92	51	71.2	4.33	<i>Michigan.</i>				
Bloomington.....	89	38	66.1	5.12	Brady, Fort.....	89	30	56.6	3.26
Collinsville.....	93	44	69.1	4.02	Harrisville.....	84	32	56.0	3.09
Charleston.....	90	43	68.1	2.99	Hudson.....	86	32	56.0	6.21
Geneseo.....	93	33	66.6	4.73	Kalamazoo.....	82	42	62.0	5.63
Mattson.....	96	43	70.6	7.05	Lansing.....	86	36	61.8	6.05
Pekin.....	94	37	69.1	7.05	Mottville.....	90	42	71.4	7.88
Peoria.....	94	44	69.8	4.08	Pontwater.....	89	33	60.4	6.65
Riley.....	85	34	60.9	2.25	Thornville.....	90	39	63.1	4.69
Rockford.....	86	37	62.2	2.25	Traverse City.....	91	35		7.61
Sandwich.....	89	39	65.9	5.13	<i>Minnesota.</i>				
South Evanston.....	89	33	61.3	3.79	Buffalo.....	86	32		
Sycamore.....	87	32	61.3	3.23	Minneapolis.....	87	32	57.7	5.44
Windsor.....	92	39	68.6	3.83	Snelling, Fort.....	88	23	59.6	3.16
<i>Indian Territory.</i>					<i>Missouri.</i>				
Gilman, Fort.....	101	40	75.9	3.75	Carthage.....	92	44	72.8	
Reno, Fort.....	106	42	75.4	1.24	Centerville.....	94	39		4.73
Supply, Fort.....	94	34	71.7	0.30	Central College.....	97	43	71.2	6.11
<i>Indiana.</i>					Conception.....	93	40	67.8	5.05
Bethelville.....	89	40	61.0	1.71	Pierce City.....	94	43	71.0	4.30
Fort Wayne.....	90	45	65.3	9.25	<i>Montana.</i>				
Jeffersonville.....	89	43	75.2	1.41	Aminaboine, Fort.....	86	36	54.7	0.99
Lafayette.....	91	39	65.8	4.39	Keogh, Fort.....	90	28	57.8	0.34
Logansport.....	90	44	68.4	5.96	Missoula, Fort.....	75	29	53.3	1.06
Mauzy.....	93	34	61.5	2.63	Shaw, Fort.....	84	29	54.8	1.10
Monticello.....	90	43	65.3	3.38					
Spiceland.....	87	40	65.3	2.47					
Sunman.....	86	38	68.7	1.52					
Terra Haute.....	87	45	69.3	1.47					
Vevay.....	91	40	69.3	1.47					

*Meteorological record of voluntary observers, etc.—Continued.*

Temperature.					Temperature.				
Stations.	Maximum.	Minimum.	Mean.	Rainfall.	Stations.	Maximum.	Minimum.	Mean.	Rainfall.
<i>Nebraska.</i>					<i>Oregon.</i>				
Brownville.....	97	43	66.7	6.36	Albany.....	96	48	63.8	1.20
Crete.....	93	37	64.1	3.21	Bandon.....	71	38	51.2	0.49
De Soto.....	94	38	64.9	3.53	East Portland.....	90	38	.....	0.04
Fairbury.....	94	30	63.6	5.15	Eola.....	91	47	62.2	1.06
Fremont.....	90	36	63.6	3.39	Klamath, Fort.....	90	19	52.8	0.00
Genoa.....	94	38	64.0	3.43	La Grande.....	89	34	.....	0.40
Hay Springs.....	92	30	57.8	0.37	Mount Angel.....	96	43	62.6	19.17
Marquette.....	94	40	.....	3.85	<i>Pennsylvania.</i>				
Niobrara, Fort.....	100	31	61.8	1.28	Altoona.....	88	40	65.9	2.45
Robinson, Fort.....	89	26	56.1	0.30	Bloomington.....	90	42	61.6	3.80
Stockham.....	94	34	61.5	1.85	Bethlehem.....	88	42	67.8	1.77
Sidney, Fort.....	90	24	59.0	0.60	Catawissa.....	88	42	.....	4.20
Tecumseh.....	95	38	76.0	4.06	Dyberry.....	87	34	59.9	5.06
<i>Nevada.</i>					Easton.....	87	47	68.2	0.85
Carson City.....	90	31	59.0	0.30	Fallsington.....	84	34	55.9	3.20
McDermitt, Fort.....	90	32	60.6	trace	Franklin.....	90	48	.....	0.81
Hallock, Fort.....	87	19	52.9	0.20	Germanstown.....	88	38	65.8	4.50
<i>New Hampshire.</i>					Grampian Hills.....	88	46	68.0	2.23
Antrim.....	.....	.....	.....	3.40	Mahanoy Plane.....	73	32	57.4	4.80
Ashland.....	.....	.....	.....	4.09	Phillipsburg.....	88	41	63.3	1.17
Belmont.....	.....	.....	.....	2.73	Quakertown.....	88	34	60.1	4.11
Berlin Mills.....	86	26	57.1	2.71	Wellsboro.....	90	45	66.5	1.10
Bristol.....	.....	.....	.....	3.95	West Chester.....	91	38	63.5	4.77
Lake Village.....	.....	.....	.....	3.70	Wilkesbarre.....	86	42	64.0	4.25
Nashua.....	87	34	60.1	4.13	Wyox.....	89	56	73.5	1.26
Wier's Bridge.....	.....	.....	.....	4.17	<i>South Carolina.</i>				
Wolfborough.....	.....	.....	.....	4.63	Kirkwood.....	82	61	72.7	2.19
Woodstock.....	.....	.....	.....	4.07	Pacolet.....	82	64	73.2	1.54
<i>New Jersey.</i>					Spartanburg.....	84	65	73.2	1.00
Beverly.....	88	36	67.7	1.29	Stateburg.....	86	60	74.1	2.05
Clayton.....	95	42	67.5	1.40	<i>Tennessee.</i>				
Dover.....	88	36	62.6	1.07	Ashwood.....	90	47	68.5	3.08
Egg Harbor City.....	93	46	67.0	1.25	Milan.....	96	46	71.5	4.77
Moorestown.....	92	46	66.2	1.04	<i>Texas.</i>				
Readington.....	92	50	70.7	.....	Austin.....	96	59	81.0	12.33
Roseland.....	.....	.....	.....	1.27	Cleburne.....	92	50	76.0	4.20
South Orange.....	86	46	62.6	1.00	Comfort.....	.....	.....	.....	3.10
Upper Montclair.....	85	43	64.9	1.33	Concho, Fort.....	95	51	75.6	0.76
Vineland.....	86	52	68.2	1.24	Corsicana.....	.....	.....	.....	5.41
<i>New Mexico.</i>					Midland.....	91	45	72.0	1.47
Bayard, Fort.....	91	44	66.7	2.93	McIntosh, Fort.....	96	62	80.4	4.40
Gallinas Spring.....	85	42	62.7	7.75	Ringgold, Fort.....	103	60	81.4	6.82
Puerto de Luna.....	87	45	63.8	3.85	New Urm.....	94	62	77.8	7.81
Selden, Fort.....	98	41	70.4	3.25	Silver Falls.....	92	42	82.0	5.58
Union, Fort.....	83	30	58.9	3.94	<i>Vermont.</i>				
Wingate, Fort.....	83	34	59.5	1.66	Brattleborough.....	88	32	60.6	4.25
<i>New York.</i>					Charlton.....	84	34	58.6	3.73
Auburn.....	86	41	61.4	4.29	Charlotte.....	88	38	60.5	4.20
Columbus, Fort.....	84	50	67.7	1.81	Lunenburg.....	86	37	59.5	3.98
Cooperstown.....	85	37	59.0	4.12	Newport.....	86	32	56.9	4.66
David's Island.....	88	30	67.9	1.84	Post Mills.....	86	29	54.5	3.04
Factoryville.....	90	40	61.0	3.01	Poultney.....	90	32	57.7	4.09
Humphrey.....	87	44	60.2	3.91	Stratford.....	84	32	60.0	4.52
Ithaca.....	90	39	61.7	3.92	<i>Virginia.</i>				
Le Roy.....	90	38	60.5	3.34	Accotink.....	89	45	69.1	1.94
North Volney.....	90	42	61.1	.....	Bird's Nest.....	93	59	75.7	1.80
Palermo.....	84	38	54.9	3.70	Brington.....	.....	.....	.....	4.90
Palmyra.....	90	44	.....	.....	Dale Enterprise.....	93	48	72.9	1.58
Penn Yan.....	.....	.....	.....	2.76	Marion.....	85	49	66.0	1.10
Plattsburg B'ks.....	87	32	58.9	2.36	Rappahannock St'n.....	92	46	71.2	2.64
Syracuse.....	91	48	.....	.....	Snowville.....	84	46	.....	.....
Setauket.....	80	45	65.7	1.03	Summit.....	95	42	68.9	.....
West Point.....	85	40	66.3	1.79	University of Va.....	80	53	66.5	1.75
White Plains.....	82	40	65.5	1.79	Variety Mills.....	89	45	67.5	1.42
<i>North Carolina.</i>					Wytheville.....	83	42	65.3	0.46
Chapel Hill.....	94	52	75.9	3.86	<i>Washington Territory.</i>				
Lenoir.....	83	53	.....	2.70	Bainbridge Island.....	82	42	48.8	1.21
Lincolnton.....	82	58	69.3	1.18	Kenewick.....	102	29	.....	0.09
Raleigh.....	90	60	76.0	4.20	Spokane, Fort.....	94	29	60.3	0.28
Reidsville.....	99	60	75.0	0.13	Tacoma.....	70	40	59.5	2.12
Statesville.....	88	58	71.1	1.80	Townsend, Fort.....	79	40	57.4	0.87
Wake Forest.....	93	52	71.9	4.48	Walla Walla, Fort.....	92	36	60.2	0.06
Weldon.....	92	56	72.0	1.75	<i>West Virginia.</i>				
<i>Ohio.</i>					Clarksburg.....	85	42	66.2	2.41
Cleveland.....	87	42	64.6	4.26	Helvetia.....	84	38	61.9	4.37
College Hill.....	93	43	69.2	3.35	Parkersburg.....	91	44	66.0	1.94
Elyria.....	90	39	64.8	3.35	<i>Wisconsin.</i>				
Garrettsville.....	91	34	60.9	2.19	Delavan.....	88	32	61.8	2.79
Hiram.....	91	43	63.3	2.45	Embarras.....	90	38	60.5	5.20
Jacksonborough.....	90	40	60.5	4.80	Fond du Lac.....	90	28	.....	3.59
Napoleon.....	88	41	64.9	5.13	Lancaster.....	92	32	60.8	.....
North Lewisburg.....	91	41	68.2	0.10	Madison.....	86	37	60.8	2.20
Portsmouth.....	89	46	66.9	3.99	Manitowoc.....	80	34	57.1	6.68
Ruggs.....	90	41	61.9	4.49	Prairie du Chien.....	92	36	62.3	3.45
Tiffin.....	90	46	65.2	4.00	Wausau.....	85	30	55.8	3.83
Tiffin.....	90	41	62.5	4.01	<i>Wyoming.</i>				
West Milton.....	95	39	65.0	7.50	Laramie, Fort.....	88	25	58.9	0.30
Wauseon.....	90	30	63.2	4.47	McKinney, Fort.....	88	31	55.8	0.70
Westerville.....	86	38	63.6	4.77	Washakie, Fort.....	90	17	57.5	0.17
Yellow Springs.....	83	41	63.6	5.09					



per cent. of rain that fell throughout the state. The season was excessively dry, and vegetation suffered very much for want of moisture. However, the bright, clear days have been favorable for gathering the rapidly-ripening cotton. The state escaped the usual September gales, and with the exception of the heavy precipitation at Tusculumbia on the 14th, 5.16 inches, there were no violent storms reported from any section. The average rainfall was 2.57 inches below the normal.

The temperature was rather high during the middle of the month but toward its close the mercury fell very rapidly, recording a degree of cold that made fires comfortable.

The average temperature of the state was 0° 3 above the normal.

#### Summary.

**Temperature.**—Mean temperature, 76°; highest temperature, 95°, at Marion, on the 12th; lowest temperature, 42°, at Gadsden, on the 30th; range of temperature, 53°; greatest monthly range of temperature, 52°, at Gadsden; least monthly range of temperature, 26°, at Selma; mean daily range, 16°; greatest daily range of temperature, 36°, at Gadsden, on the 30th; least daily range of temperature, 1°, at Eufaula, on the 30th, and Florence, on the 15th.

**Rainfall.**—Mean depth of rainfall, 1.46 inches; mean daily rainfall, 0.052 inch; greatest depth of monthly rainfall, 6.90 inches, at Tusculumbia; least depth of monthly rainfall, 0.30 inch, at Marion and Selma; greatest daily rainfall average for state, 0.68 inch, on the 14th; greatest daily local rainfall, 5.16 inches, at Tusculumbia, on the 14th.

Average number of days on which rain fell, 5; average number of cloudy days, 6; average number of fair days, 13; average number of clear days, 11.

Warmest days, 11th, 12th, and 17th; coldest day, 30th.

Prevailing directions of wind, east and southeast.

The following meteorological summary for September, 1886, has been forwarded by Hon. J. T. Henderson, Commissioner of Agriculture for Georgia:

Districts.	Temperature.			Average precipitation.
	Highest.	Lowest.	Monthly mean.	
	°	°	°	Inches.
Northern Georgia .....	90.0	51.0	72.4	0.80
Middle Georgia .....	95.0	48.0	75.1	0.87
Southwestern Georgia .....	94.0	59.0	79.1	3.57
Eastern Georgia .....	98.0	64.0	77.7	0.95
Southeastern Georgia .....	88.0	66.0	77.8	5.40
Means for state .....	95.0	48.0	76.4	2.32

The following is an extract from the "Weather Review of the Illinois Department of Agriculture," for September, 1886, prepared under direction of Col. Charles F. Mills, Springfield:

**Divisions.**—The state covers such an extended area from north to south (385 miles) that it has been found advisable to divide the same and follow the judicial divisions, which include the following territory, viz.: the northern division extends from 42° 30' to about 40° 31'; the central division extends from about 40° 31' to about 39°; the southern division from about 39° to 36° 51'.

**Temperature.**—The mean temperature of the state for the month, 67° 8, was 2° 4 above the normal for twelve years. The mean temperature of the northern division was 65° 4; of the central division, 67° 9, and of the southern division, 70° 2.

The greatest departure from the normal was at Peoria, Peoria county, where it was 2° 8 above the normal for thirty years.

The maximum September temperatures are as follows: 1881, 101°; 1882, 95°; 1883, 96°; 1884, 99° 5; 1885, 94°, and 1886, 98°. The minimum temperatures are, in 1881, 42°; 1882, 30°; 1883, 31°; 1884, 41°; 1885, 30°, and 1886, 32°.

The highest temperature reported during the month, 98°, occurred at Pontiac, Livingston county, on the 8th and 9th; at Sumner, Lawrence county, on the 8th, and at Centralia, Marion county, on the 9th. The lowest reported, 32°, occurred at Pontiac on the 29th, making the absolute range for that place 66° for the month.

The hot wave of the 5th to 9th and cool wave of the 29th and 30th extended over the entire state. Several stations in the southern division report the highest temperature on the 23d and 24th, but they are the exceptions.

**Precipitation.**—The average precipitation for the state was 4.67 inches; for the northern division, 4.03 inches; central division, 5.68 inches, and southern division, 4.30 inches. It was 1.37 inches above the September normal for the state; 0.85 of an inch above the September normal for the northern division; 2.43 inches above for the central division, and 0.94 of an inch above for the southern division.

The greatest departures from the normal precipitation occurred as follows: Greenville, Bond county, 2.18 inches above; Pana, Christian county, 3.94 above; Aurora, Kane county, 2.60 below; Griggsville, Pike county, 2.05 above; Springfield, Sangamon county, 3.60 above; Mascoutah, Saint Clair county, 2.49 above, and Fairfield, Wayne county, 2.15 inches above.

The following meteorological summary and accompanying

remarks are from the September, 1886, report of the "Indiana Weather Service," under direction of Prof. H. A. Huston, of Purdue University, Lafayette:

Districts.	Temperature.			Average precipitation.
	Highest.	Lowest.	Monthly mean.	
	°	°	°	Inches.
Northern counties .....	96.0	39.0	65.5	7.81
Central counties .....	91.0	34.0	65.4	3.94
Southern counties .....	97.0	40.0	68.1	1.80
State .....	97.0	34.0	66.3	4.52

The mean temperature of the state for September, 1886, was 1° 6 above the mean of September for the past five years; 1° 4 above the mean of sixteen years at Indianapolis; 0° 5 above the mean of thirty-one years at Logansport; 2° 4 below the mean of twenty-one years at Vevay; 2° 6 above the mean of thirty-three years at Spiceland; 1° 8 above the mean of seven years at Maury; 2° 6 below the mean of nine years at Blue Lick; the same as the mean of five years at Worthington; 1° 0 above the mean of seven years at Lafayette. The mean temperature at various stations ranges from 2° 4 above the average at Logansport to 3° 7 below the average at Maury.

The mean precipitation for the state for September was 1.16 inches above the mean of September for the past five years; 1.83 inches above the mean of sixteen years at Indianapolis; 1.54 inches above the mean of thirty-one years at Logansport; 1.09 inches above the mean of twenty-one years at Vevay; 1.15 inches above the mean of twenty-eight years at Spiceland; .78 inch below the mean of seven years at Maury; 1.18 inches above the mean of five years at Blue Lick; 1.03 inches above the mean of five years at Worthington; 1.66 inches above the mean of seven years at Lafayette. The precipitation at various stations ranged from 2.92 inches above the average at Logansport to 2.73 inches below the average at Maury.

The following is from an advance sheet of the "Iowa Weather Bulletin," for September, 1886, prepared under direction of Gustavus Hinrichs, M. D., Iowa City:

September, 1886, was warm and fair, southerly winds and calms largely prevailing; the rainfall was showery and generally in excess of normal.

The mean temperature of the air was two degrees above normal. Since 1871, September has been decidedly warmer twice only, namely, in 1884 and 1881; in 1877 it was slightly warmer than this year. Eight times during the twenty years from 1851 to 1870 has September been decidedly warmer than this year. The first and last decades were quite warm, being over four degrees above normal; the middle decade was decidedly cool, being nearly four degrees below normal.

Cloudiness was about normal, with a slight excess of clear days. Southerly winds or calms prevailed at two-thirds of all the observations. The total run of the wind was also less than normal.

Rainfall was much more frequent than normal, and brought about a wonderful change in the pastures throughout the state. In amount the rainfall was less than four inches in the northwest and east; throughout the balance of the state it exceeded four inches. The southwest and southern-central Iowa received over six inches of rainfall. This high rainfall extended northeastward to Waterloo.

The most notable storm was the squall of the 18th, which attained its greatest intensity in wind, rain, hail, and lightning in southeastern Iowa late in the afternoon.

Fine days were quite frequent. The 29th was especially fine and cool.

While very light frosts occurred locally on lowlands during the latter half of the second decade, the frost of the 29th was the first really general frost of the season; it found the corn perfectly mature and most corn fodder saved in shocks.

No northern lights or other notable phenomena were reported. Damage by lightning has been exceptionally great this month.

The following is from the September, 1886, report of the "Minnesota Weather Service," under direction of Prof. Wm. W. Payne, Carleton College, Northfield:

The severe drought and unusually high temperature which characterized August were notably absent in September just past.

The mean temperature for the state, as deduced from the reports of fifteen stations, is 57° 1, which is 1° 6 below that of the corresponding month of September, 1885. At Duluth it was 5° 0 below the mean of sixteen years; Saint Vincent, 1° 7 below the mean of fourteen years; Moorhead, 1° 6 below the mean of five years; Saint Paul, 0° 8 below the mean of sixteen years; and 0° 2 above the mean of fourteen years at La Crosse. Thus showing from stations where records have been kept for a number of years that the mean temperature was generally below the average, with the departure most decided in the northeastern portion of the state. The maximum temperature registered was 93° 0, at Sherburne, on the 4th, while the minimum was 22° 7, at Moorhead, on the 18th, thus making the range for the state 70° 3. The greatest monthly range of temperature at any one place was 67° 4, at Moorhead, while the least monthly range was 47° 8, at Duluth.

Rain fell generally over the entire state, the average being 4.05 inches, while the greatest amount which fell at any one place was 6.07 inches, at Mankato; the least amount was reported from Moorhead, where the fall amounted to 1.31 inches. The greatest daily rainfall was 2.10 inches, which occurred on the 25th, at Morris. At Duluth, for the month, there was an excess of 1.52 inches of rainfall; Saint Vincent, 1.45 inches; Saint Paul, 0.31 of an inch, and a deficiency at La Crosse of 1.73 inches, and Moorhead, 0.64 of an inch. Stations that reported over an inch of rainfall on any one day, with the dates, are: Dodge Centre, 18th, 1.50; Red Wing, 15th, 1.49, and 18th, 1.18; Mankato, 15th, 1.35, and 18th, 1.30; Rochester, 11th, 1.02; Morris, 15th, 1.85, and 25th, 2.10; Saint Paul, 7th, 1.20; Duluth, 6th, 1.06, and 25th, 1.90; Alexandria, 24th, 1.05.

Thunder-storms were of almost daily occurrence throughout the state during the first fifteen days of the month, but were more numerous reported on the 2d, 3d, 5th, 6th, 15th, 24th, and 26th.

Hail was reported from Saint Vincent on the 5th, and Red Wing on the 15th.

Frosts occurred at Albert Lea on the 17th, 28th, 30th; Sherburne, 19th, 30th; Red Wing, 14th, 28th; Mankato, 29th, 30th; Morris, 30th; La Crosse, 14th, 17th, 28th, 29th; Saint Paul, 28th; Saint Vincent (light), 1st, 8th, 12th (killing), 13th, 14th, 18th, 19th; Duluth, 1st 12th, 13th, 14th, 17th; Moorhead (killing), 12th, 17th, 18th, 28th.

The following is from the September, 1886, report of the "Nebraska Weather Service," under direction of Prof. Goodwin D. Swezey, of Doane College, Crete:

Like the month of August there has been no marked peculiarity in the weather of September unless it is the cold wave, the first of the season, that appeared on the night of the 29th in Minnesota, and extended on the 30th to east Dakota, Iowa, Nebraska, Wisconsin, Michigan, Illinois, Missouri, Indiana, and Ohio, with a minimum temperature of 33°.8 in Nebraska. This was predicted as a cool wave, although cold-wave flags were not ordered up; but the temperature fell lower than was expected.

Four storms, of moderate severity, were felt in Nebraska during the month. The first appeared in northern Dakota on the 14th and was joined on the 15th by a storm which formed in northern Kansas. The second appeared in the Indian Territory on the 18th and moved very rapidly eastward, passing out of the Saint Lawrence Valley on the 19th. The third formed in Colorado on the 24th and moved northeastward. The fourth formed in Colorado on the 26th and, passing northeastward, moved out of the Saint Lawrence Valley on the 28th. All of these were attended by more or less rainfall in the state.

#### Comparison of past Septembers.

The table shows the mean temperature, the noon temperature, and the number of days above 85° for the past nine Septembers in southeastern Nebraska; they are found by averaging the numbers reported at the different stations. It also shows the highest temperatures and the lowest recorded anywhere in the state by standard self-registering thermometers:

September.	Mean temperature.	Noon temperature.	Above 85°.	Highest temperature.	Lowest temperature.
	°	°	Days.	°	°
1878.....	65.5	75.9	5.3	91.0	33.0
1879.....	61.1	75.1	3.9	91.0	28.0
1880.....	64.2	73.8	3.7	93.0	34.0
1881.....	67.3	76.5	10.3	99.0	36.0
1882.....	67.5	80.8	10.8	94.0	40.8
1883.....	60.8	70.7	2.0	91.0	37.0
1884.....	67.9	76.1	6.3	91.8	39.0
1885.....	64	78.0	5.0	92.0	42.6
1886.....	65.4	75.5	9.2	93.3	33.8

The following table shows the precipitation, or depth in inches of rain and melted snow or hail, the number of days on which it fell, and the number of cloudy and of clear days. Days are counted cloudy when the sky is four-fifths overcast; clear when less than one-third. The last column shows the number of thunder-storms:

September.	Precipitation.	Days of precipitation.	Cloudy days.	Clear days.	Thunder.
	Inches.				
1878.....	3.58	4.3	1.9	18.7	2.2
1879.....	1.86	5.1	1.5	19.0	2.8
1880.....	3.41	6.9	2.5	16.5	4.3
1881.....	4.05	6.5	3.8	17.2	5.5
1882.....	0.92	1.9	1.4	19.3	2.0
1883.....	3.35	7.1	6.4	14.0	3.5
1884.....	2.99	5.8	5.3	13.0	4.9
1885.....	2.34	6.3	6.0	16.4	2.7
1886.....	3.59	9.9	4.9	19.3	4.7

The following is an extract from the September, 1886, report of the "Missouri Weather Service," under direction of Prof. Francis E. Nipher, Washington University, Saint Louis:

The mean temperature for September has been 71°.3, which is 2°.3 above the normal. The extremes of temperature were 52° on the 29th and 91°.5

on the 9th. The extreme minimum of September has in former years fallen to or below that of the past month over thirty times, in fact upon every day of the month, and ten times since 1836 the observations of Engelmann show a September temperature of over 95°, the highest being 102°, on September 9, 1864. The temperature has therefore been about normal, and quite uniform in character.

At Saint Louis the rainfall, 9.57 inches, has been in excess of the normal value by 6.6 inches, the normal value being 3 inches. The rainfall in the state has been greatest at Saint Louis, diminishing to about 3 inches in the north, west, and south part of the state. The heaviest rain, over 7 inches, occurred in two areas, the one being east of a line running from the mouth of the Missouri River southward to Potosi and thence eastward into Illinois. The other maximum area lies in a belt stretching from Macon eastward into Illinois, where these two areas probably unite.

The mean temperature in the state has been lowest at Ironton, being 64°.3, the highest being at the Signal Office, Saint Louis, 72°.1; Mascoutah, 72°. The lowest minimum, 38°, was reported from Ironton and Mound City. The highest maximum was Miami, 103°; Mound City, 99°.5; Mexico, 99°; Sedalia, 98°; Savannah, Houstonia, and Signal Office at Leavenworth, 97°.

The experience of the past summer should give the farmers of the Northwest great confidence in the soil which they possess. Notwithstanding the severe drouth, the feeding value of the corn crop is probably fully up to the average, while the hay and oat crop, of about normal quantity, was unusually good in quality.

The following summary for September, 1886, is from the "Bulletin of the New England Meteorological Society," published under direction of Prof. Winslow Upton, Providence, Rhode Island:

#### Summary for September, 1886.

Reports for the month were received from one hundred and forty-one observers.

The first third of the month was fair and dry; the remainder brought frequent rains accompanying the several cyclonic storms of the month, and the last week was generally cloudy and rainy. All the storm-centres passed north of us over Canada, no tropical cyclone approaching near enough to affect our weather. The varying conditions as to temperature and rainfall in the different parts of the month balanced one another, and the average was close to the normal.

**First period; fair.**—High pressure with fair weather characterized the first ten days of the month. At a few of the eastern stations the first day gave a little rain that should be referred to the last cyclonic area of August; then came five or six days of cool weather with northwesterly winds in front of the centre of high pressure, followed by four or five days of warmer weather with southerly winds as the pressure fell.

**Second period; variable.**—Light rain occurred at some northern stations, with a faint northern barometric depression on the 9th; more general rains fell on the nights of the 10-11th and 12-13th, while two distinct cyclonic areas moved over Canada, with a day of fair weather and higher pressure between. Another anti-cyclonic area passed us on the 15th, followed by a cyclonic area, traversing Canada on the 16th and 17th, giving us rain with thunder-storms and squalls on the afternoon of the 16th. On the 18th the pressure was again high, but fell as the fourth cyclonic storm approached and passed on the night of the 19th, with rain and thunder.

**Third period; fair.**—Three days, from the 20th to the 23d, had high pressure, with brisk, cool, northwest wind and fair weather.

**Fourth period; rainy.**—Rain fell on the 23d between the passage of two anti-cyclonic areas; rain was again frequent from the 25th to the 28th or 29th, while an area of low pressure lingered over the Lakes and Canada. The last two days of the month were generally fair.

Thunder was noted in one part or another of New England in connection with nearly every rain of the month. Light thunder showers occurred in New Hampshire and Vermont on the 9th, 10th, or 11th, and in Connecticut and Long Island on the 12th. A storm of some violence, with strong wind, heavy rain, and destructive lightning, appeared in western Massachusetts about 3 p. m., and reached the coast after 9 p. m.; it was followed by a second one in the western and central parts of the state two or three hours later. One of these storms, probably the earlier, was felt from northwestern Connecticut into southern Maine, and its lightning was visible on Long Island. A thunder-storm on the evening of 19th extended from Connecticut to Maine. A smaller one appeared on the southern coast on the morning of the 23d, and a wide-spread thunder-storm accompanied the rain of the 28th and 29th, extending from the upper Connecticut River to western Massachusetts about midnight of these dates, avoiding eastern Massachusetts, and moving obliquely into Maine in the early hours of the 29th.

A tornado occurred four miles east of Hartford, Connecticut, on the evening of the 12th.

The following is from the September, 1886, report of the "Ohio Meteorological Bureau," under direction of Prof. B. F. Thomas, of the Ohio State University, Columbus:

The mean temperature, 65°.5, was slightly above the average, which is 64°.8. The September normal (or average for many years) is 65°.38. The range of temperature for the month was only 61°, the range for the preceding three years varying from 67° to 72°.2. The mean daily temperature range was likewise low, being 22°.2, the average being 22°.9.



The rainfall was the heaviest in four years. The normal fall for September is 2.72 inches, but the mean for the month just closed was 4.02. The greatest rainfall recorded was 10.25 inches, at Sidney; the least, 1.3 inches, at Cincinnati.

#### Summary.

Mean temperature, 65°.5; highest temperature, 94°.0, on the 9th, at Logan; lowest temperature, 33°.0, on the 21st, at Paulding; range of temperature, 61°.0; mean daily range of temperature, 22°.2. greatest daily range of temperature, 44°.0, on the 3d, at Paulding; least daily range of temperature, 2°.0, on the 12th, at Clarksville.

Average number of clear days, 12.7; average number of fair days, 12.4; average number of cloudy days, 4.9; average number of days on which rain fell, 10.1.

Mean rainfall, 4.02 inches; average daily rainfall, .134 inch; greatest number of days on which rain fell, 16, at Toledo and Wauseon; least number of days on which rain fell, 5, at Oberlin and Weymouth; greatest rainfall, 10.25 inches, at Sidney; least rainfall, 1.30 inches, at Cincinnati.

Prevailing direction of wind, southwest.

The following is an extract from the "Tennessee State Board of Health Bulletin," for September, 1886, prepared under the direction of J. D. Plunkett, M. D., President of the State Board of Health. The weather report is prepared by H. C. Bate, in charge of the State Meteorological Service:

The general meteorological conditions during the month of September showed but little departure from the means of the three previous years. The temperature was, perhaps, slightly above the normal.

The mean temperature was 70°.4, about one degree above the mean for September, 1885, and nearly three degrees below that for the corresponding period in 1884. The highest temperature was 96°, recorded on the 10th, and was three degrees above the maximum of September of last year, and one degree below the maximum of September, 1884. The warm wave, which began about the 7th, was followed close by a cool one and a fall of several degrees about the 12-14th, and this, in turn, was succeeded by another warm wave, which culminated about the 17-18th, and which continued with very slight variations until the last few days of the month, when a marked depression was noted, and, on the 30th, the lowest temperature of the month, 38°, was recorded. This was four degrees above the minimum recorded in September of last year, and three degrees below that in September of the year previous. The proportion of cloudiness during the month was below the normal.

The mean precipitation was 3.11 inches, a little more than half an inch less than the mean for September of last year, and about an inch more than the mean of September of the year previous. It was slightly below the normal in the eastern portion of the state, and above the normal in the western portion. Of the amount the eastern division received an average of less than two inches, the middle division an average of about three and one-fourth inches, and the western division an average of about four and three-fourth inches. The greatest rainfall was 6.19 inches, reported at Memphis. This was the greatest September rainfall reported at that station since its establishment in 1871. The least rainfall reported for the month was 1.07 inches, at Chattanooga, and was the least reported at that station for September since the establishment of the station in 1879. Even this is considerably over the minimum September precipitation of any three preceding years. The greatest local daily rainfall occurred at Savannah on the 15th, and measured 2.10 inches. A daily fall of two inches was reported on the same day at Fostoria, also a like amount on the day previous at Howell.

The rains of the 12th, 14th, 15th, 27th, and 28th were general, the others were mostly very light and local. The rain of the 14th was the heaviest during the month, an average of more than one inch falling throughout the state on that day. This was followed by a heavy fall the next day. There was comparatively little electrical disturbance during the month, and no very high winds. There were ten days reported without rain. The prevailing winds were southeasterly.

#### State summary.

Mean temperature, 70°.4; highest temperature, 96°, on the 10th, at Milan; lowest temperature, 38°, on the 30th, at Farmingdale; range of temperature, 58°; mean monthly range of temperature, 42°.4; greatest monthly range of temperature, 51°, at Farmingdale; least monthly range of temperature, 32°, at Careyville; mean daily range of temperature, 17°.3; greatest daily range of temperature, 34°, on the 22d, at Milan; least daily range of temperature, 2°, on the 15th, at Hurricane Switch; mean of maximum temperatures, 88.8°; mean of minimum temperatures, 46°.4.

Average number of clear days, 16.2; average number of fair days, 7.4; average number of cloudy days, 6.4; average number of days on which rain fell, 6.2.

Mean depth of rainfall, 3.11 inches; mean daily rainfall, 0.103 inch; greatest rainfall, 6.19 inches, at Memphis; least rainfall, 1.07 inches, at Chattanooga; greatest local daily rainfall, 2.10 inches, on the 15th, at Savannah; days of greatest rainfall, 12th, 14th, 15th, 28th; day of greatest rainfall, 14th; days without rainfall, 1st, 2d, 3d, 4th, 5th, 9th, 21st, 22d, 24th, 30th.

Warmest day, 10th; coldest day, 30th.

Prevailing winds, south and southeast.

The study of the motions of the upper currents of the atmosphere is of so great importance that it has been deemed wise

to present the following abstract of a paper by Prof. J. Kiessling, of Hamburg, Germany, published in the "Sitzungsber. der Kgl. Preuss. Akad. d. Wiss. zu Berlin," 1886, page 529:

#### THE MOTION OF KRAKATOA SMOKE IN SEPTEMBER, 1883.

[Translation from the German by Junior Prof. H. A. HAZEN.]

Mr. W. Siemens, in his investigation upon the conservation of energy in the earth's atmosphere, considers that this is dependent upon the rotation-velocity, and he draws the conclusion that by the general air circulation between 35° north and south latitude, as well in the upper poleward directed air current as in the lower along the equator, there is a lagging behind the earth's rotation, hence it must be directed to the west, and that by wholly lacking friction this velocity on the equator must amount to 84 metres per second (188 miles per hour), from east to west. The optical appearances following upon the outburst of Krakatoa places the theoretical considerations in the hand of experience for proof, since the paths of the smoke masses thrown into very high atmospheric layers immediately after the outburst could be clearly followed more than a week.

I present the following from the results obtained from a discussion of the geographical relations established by observations:

The outburst occurred at the time of the year when the sun's heat is greatest along the northerly tropic. If the view of Mr. Siemens be correct, at this time of year, not only the middle line of the equatorial air ring, but also the turning point on the south side of this ring of the spirally rising trade-current, must lie in the neighborhood of the north tropic. Since in the first outburst of Krakatoa, on May 20, 1883, the smoke column reached a measured height of 11,000 metres (7 miles), we may consider that in the incomparably heavier explosion of August 27th smoke and dust masses penetrated through the lower trade current into the upper trades. Both streams then on August 27th must have carried smoke clouds in a circular path about the earth.

The observations appear to establish the correctness of this conclusion. From a study of ships' journals I have been able to place upon a chart the course of each ship whose captain had made note of special appearances during this period. Thereby it is possible to obtain at a full glance just the conditions of the equatorial zone in which the volcanic smoke clouds were clearly seen. The supposition is probable that those captains who have made any note of the appearances have written complete journals, so that we must conclude that the lack of a note is due to the absence of any strange optical appearance.

This chart gives the following:

(1.) By far the greater portion of the general smoke mass had a west-by-north motion at the equator.

(2.) These smoke masses did not form a single cloud, as considered by Mr. Ringwood, Sereno Bishop, and Verbeck, but perhaps a succession of clouds of different magnitude, of which those in a meridional direction were so small that they could be sailed through in a few days from north to south. From the difference of time of the appearances at various places it is possible to calculate a mean velocity of the general motion. The exact moment of time at which the motion of the smoke masses begun cannot be told, as already on August 26th west of Krakatoa there were appearances clearly due to smoke clouds, while the principal eruption was on August 27th. In spite of this uncertainty it is possible to calculate the mean velocity of the smoke masses which passed across the equator in a north direction, as also of those which moved along the equator, this was the same for both, and amounted to 36 to 40 metres per second (81 to 89 miles per hour).

(3.) Small parts of the principal mass along the equator toward the north and south lag behind in their motion.

(4.) When a ship with a west course reaches a cloud so is there first a blue or green color of the sun and still later an extraordinary increase in the twilight colors. Now we have experimental proof that the so-called sun colors, through a fine and thick smoke, were wholly independent of the chemical composition of the ingredients, while the intense diffraction colors were formed only through homogeneous, i. e., uniform particles forming a cloud. The succession of the appearances is therefore an indirect proof of the correctness of the view that they were formed by smoke clouds which had a motion from east to west in the lower part of the atmosphere.

(5.) It is possible to follow the smoke clouds in a south-southwest direction; these show an original velocity of 30 to 40 metres per second (67 to 89 miles per hour) in a west direction; moreover, already in the middle of September they have advanced to 40° south latitude, and have asserted their optical properties in Australia, Africa, and America.

(6.) Near both these it is possible easily to follow, in a north-northeast direction, smoke clouds along the Chinese coast to Japan. They were observed at the light-houses "Fisher Island," "Middle Dog," "Chefoo," and on August 30th in Tokio; this shows a velocity of 20 metres per second (45 miles per hour).

(7.) Toward the northeast from Krakatoa strange appearances are not observed immediately after the eruption. Hence, fourteen days later, sun colors are noted at Borneo, due to smoke masses coming up after a complete circuit of the earth from the east. On the other hand, in an easterly direction at Boeleleng in Bali, two to three days after the outburst, a considerable darkening, and at New Ireland an unusual color of the heavens, were observed. This would seem to show an undoubted easterly air current.

It is possible to show, from competent side deliberations, how from the winter of 1883-'84 to the autumn of 1885, in the region of the temperate zone, there were observed optical appearances in causal connection with the Krakatoa outburst. What quantity of particles thrown into the atmosphere

would be needed in order that, by their propagation above so great a part of the world, they might make the marked appearances? Further, what sufficient influence can there be over the weight of the particles so that dust could be held two years floating in the atmosphere?

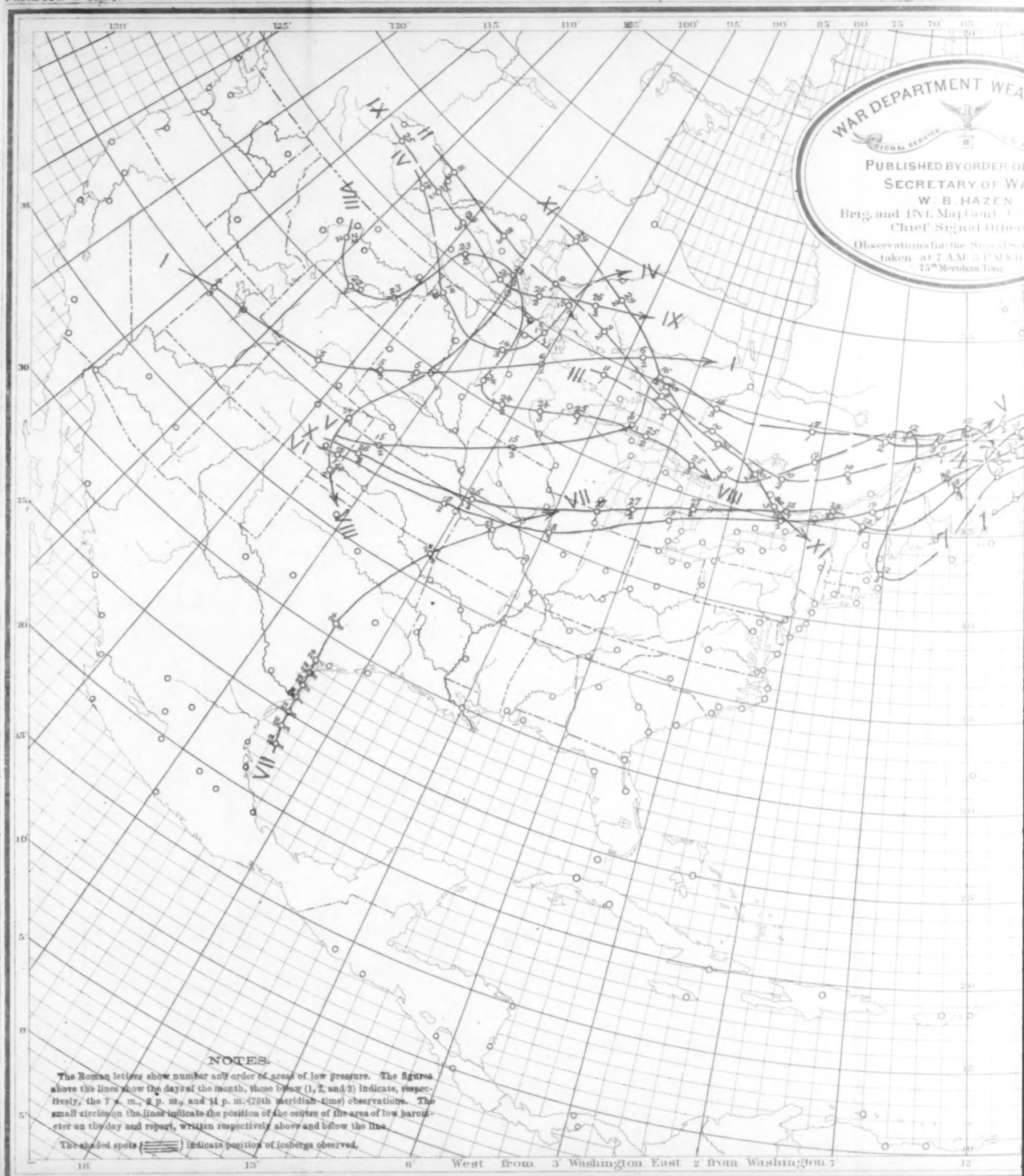
Both objections are of no weight as shown by experimental proof. It is easy to show that air which is full of extremely fine dust, or artificially ground Krakatoa dust, has very little influence in the development of homogeneous clouds, that is, clouds consisting of uniform water-drops, in comparison with the powerful cloud-forming action which comes from such gases of combustion as are beyond observation by direct optical means. Hence a computation of the quantity of solid ingredients of the Krakatoa outburst is of no importance in determining the causes which lie at the base of the above optical appearances.

This is confirmed also by the observed appearances through the summer of 1831, immediately after the submarine eruption of the island of Ferdinandea, the development of abundant sulphur-bearing products was then so great that the German savant, Professor Hoffmann, Drs. Philippi and Schultz, at the

end of July, found in Sciakka different silver vessels which were plainly attacked by the volcanic gases. The height of the appearance as measured by Professor Hoffmann and Dr. Schultz, at points fourteen nautical miles apart, was plainly 20 k. m. (12.4 miles). It is worthy of note that the gas thrown into the air in the south of Sicily, asserted its optical effects from August 2-4th, nearly simultaneously in Madrid, Genoa, Rome, Berlin, Odessa, Irkutsk, and Werchneudinsk. The many letters collected by me show that the same optical effect was observed in very high-lying cloud layers.

The question of the suspension of smoke masses and the resulting condensation products in high atmospheric layers, finds an easy experimental solution. From a long series of investigations with extremely fine smoke, whose ingredients did not appear to permit microscopic measures, a falling velocity of .003 m. per minute, at the ordinary air pressure, has been determined. At a height of 20 k. m. (12.4 miles), this velocity would amount (according to Ferrel's formula) to about .01 m. per minute, therefore in one year it would fall, if the air were perfectly quiet, 5,300 m. (17,389 feet) at the most.





# Areas of Low Pressure. September, 1886.





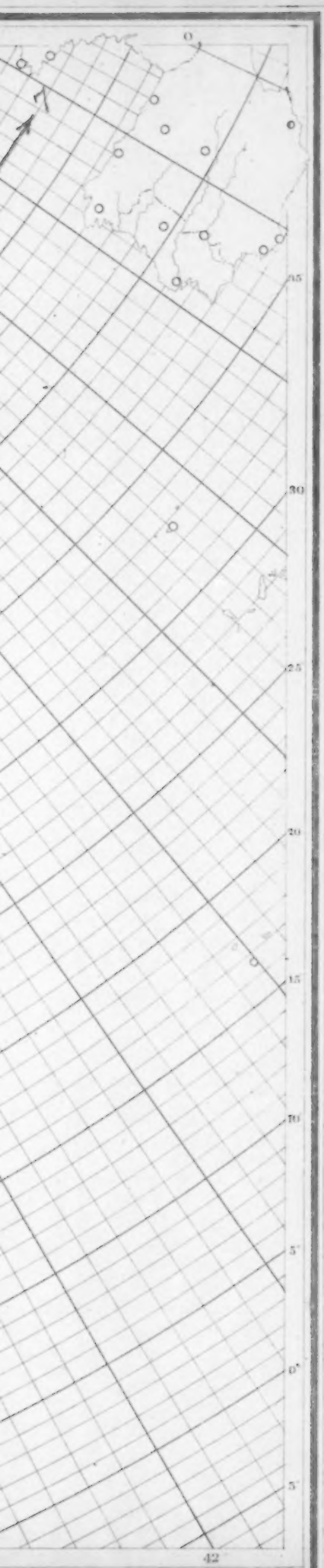
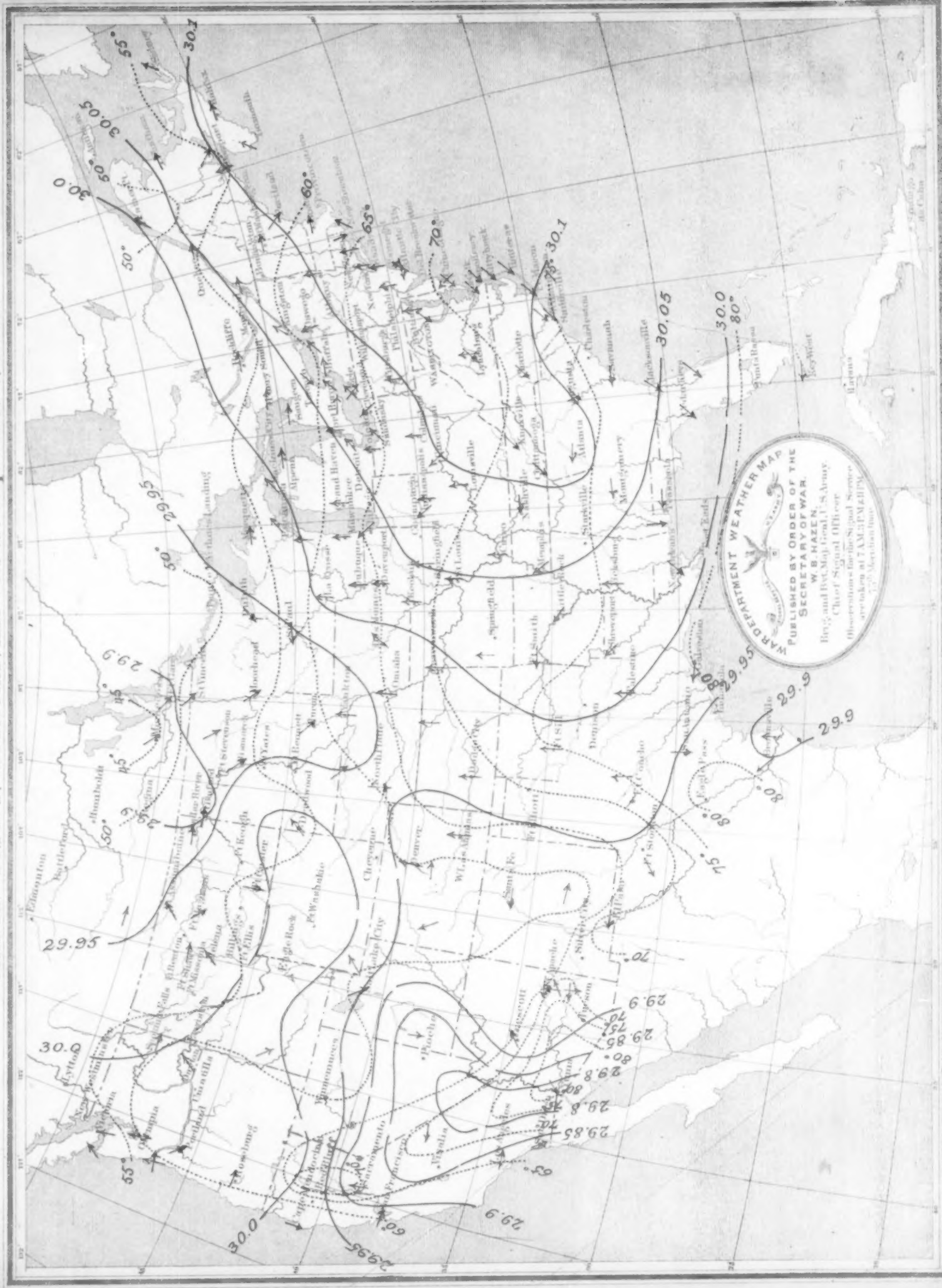






Chart II. Isobars, Isotherms, and Winds. September, 1886.

Form 106 F.







# Chart III. Precipitation, September, 1886.

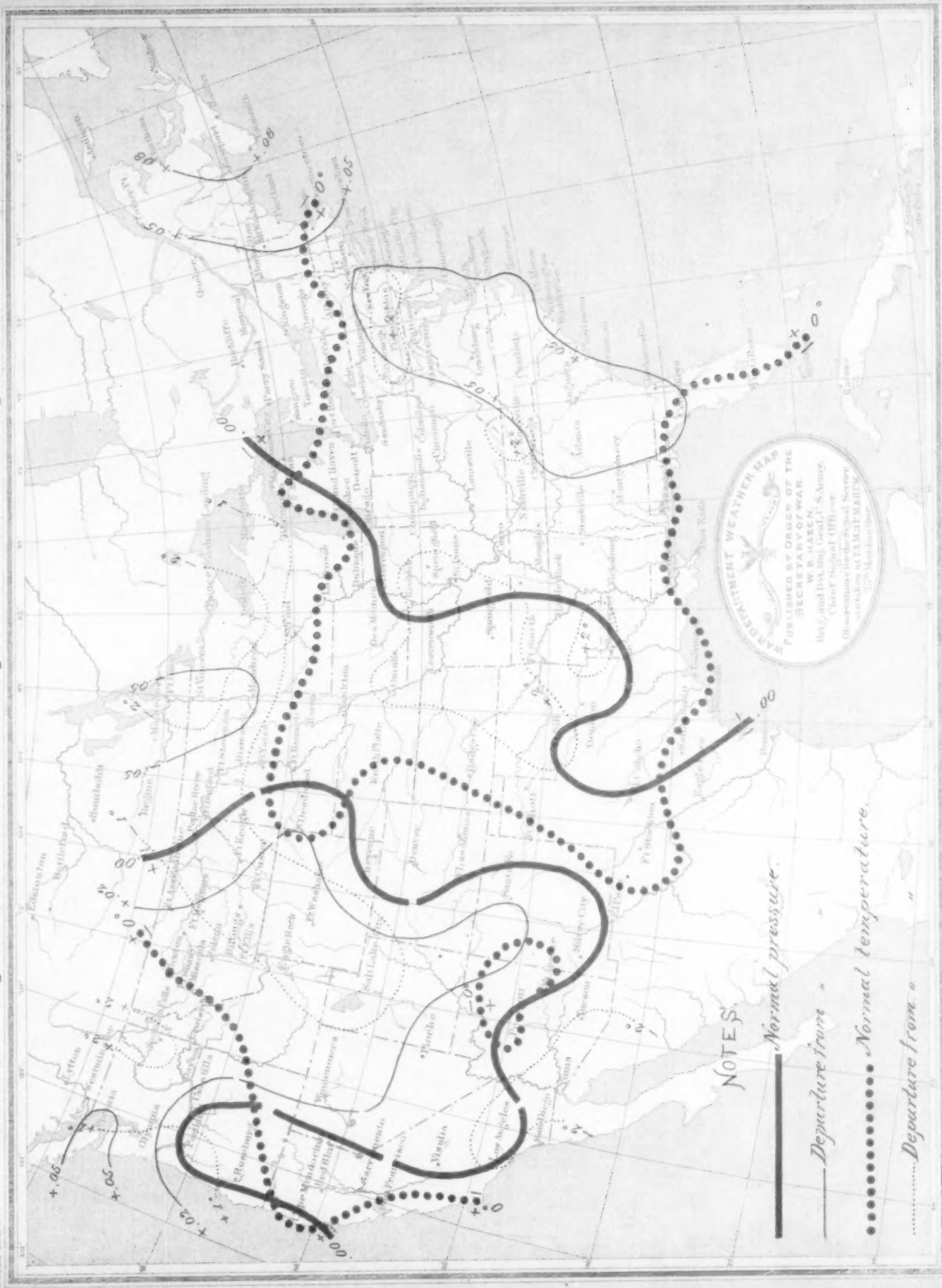






Chart IV. Departures from Normal Atmospheric Pressure and Temperature. September, 1886.

Form 106 F



MANUFACTURED BY THE  
PUBLISHED BY ORDER OF THE  
SECRETARY OF WAR  
W. B. HAZEN,  
Brig. and Maj. Genl., U. S. Army,  
Chief Signal Officer  
(Observations for the Signal Service  
are taken at 7 A.M. and 3 P.M.)

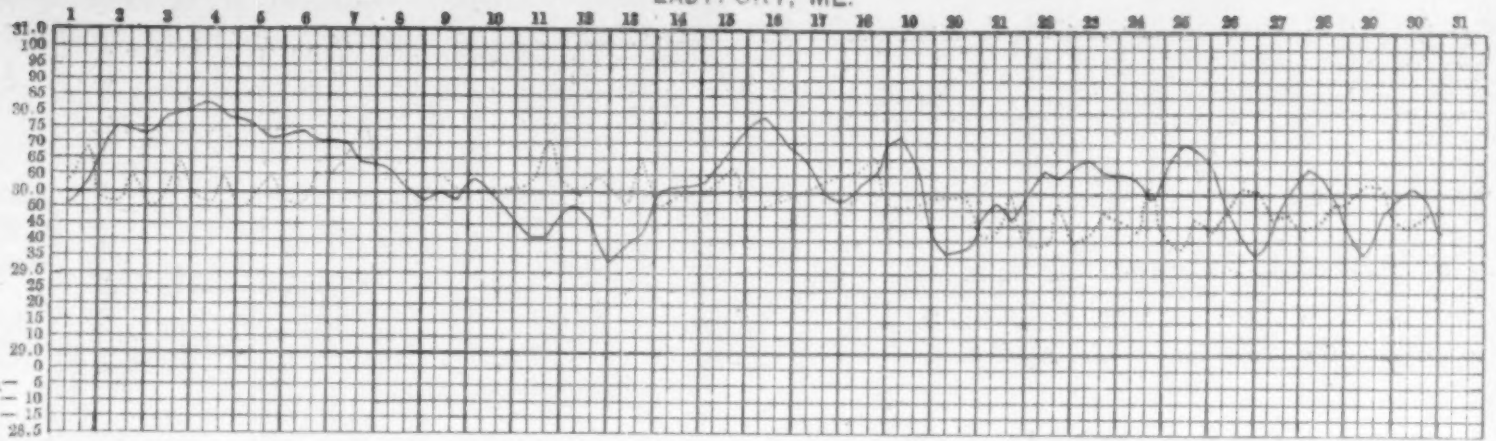
NOTES:  
 ————— Normal pressure.  
 ————— Departure from "  
 ..... Normal temperature.  
 ..... Departure from "



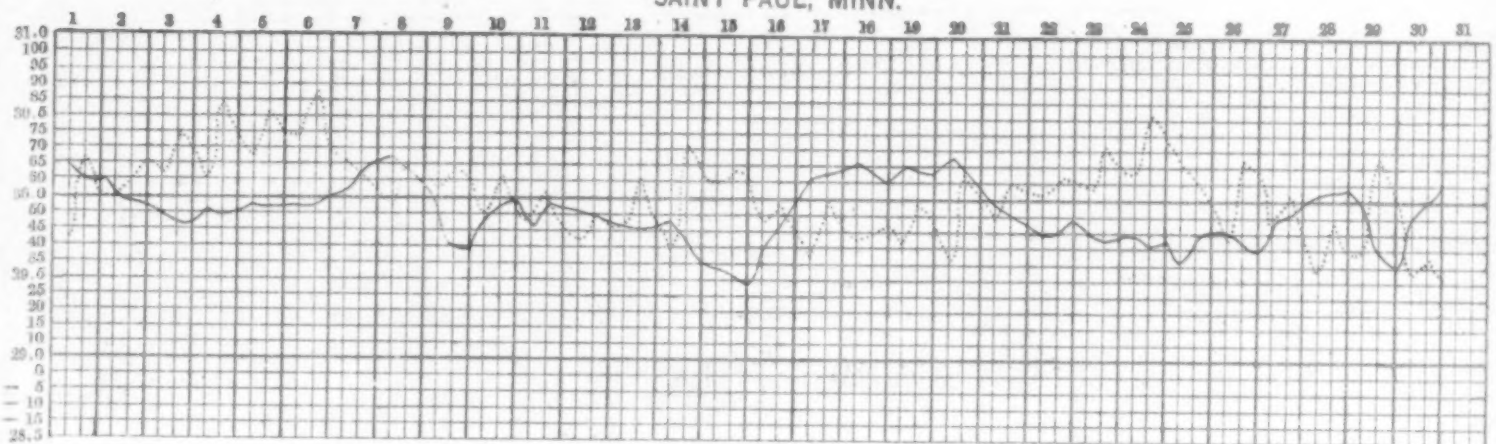


Chart V. Pressure (—) and Temperature (.....) Curves. September, 1886.

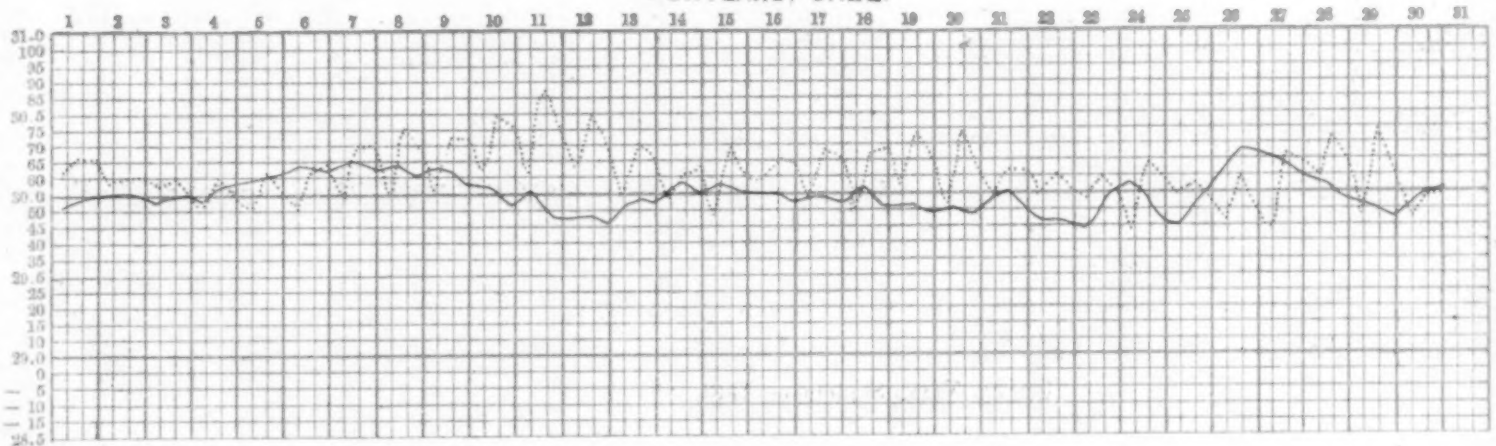
EASTPORT, ME.



SAINT PAUL, MINN.



PORTLAND, OREG.



NEW ORLEANS, LA.

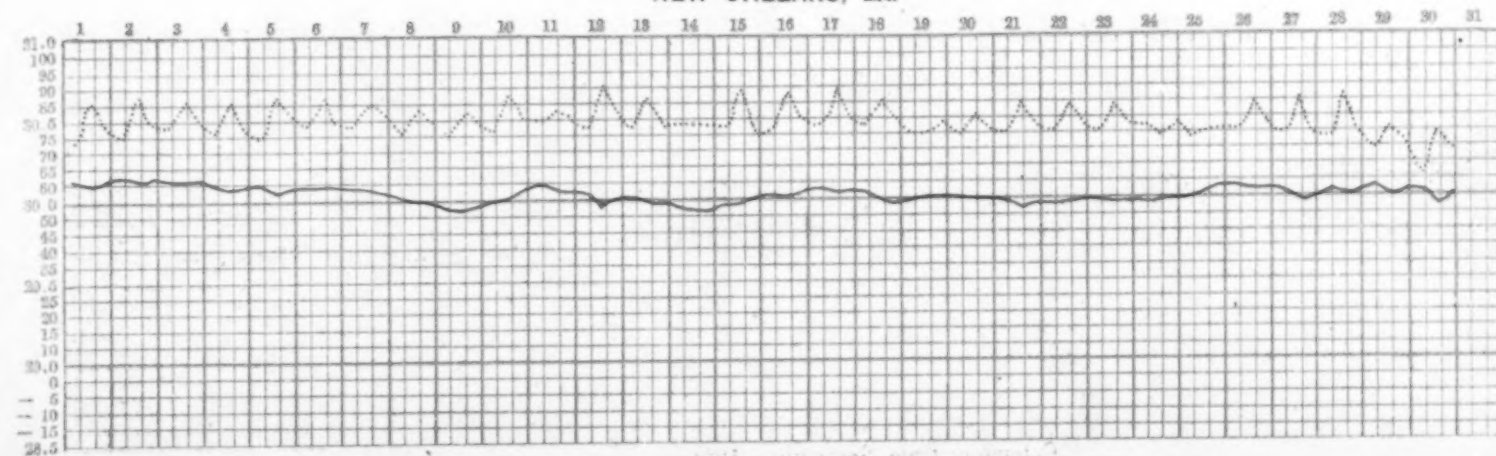
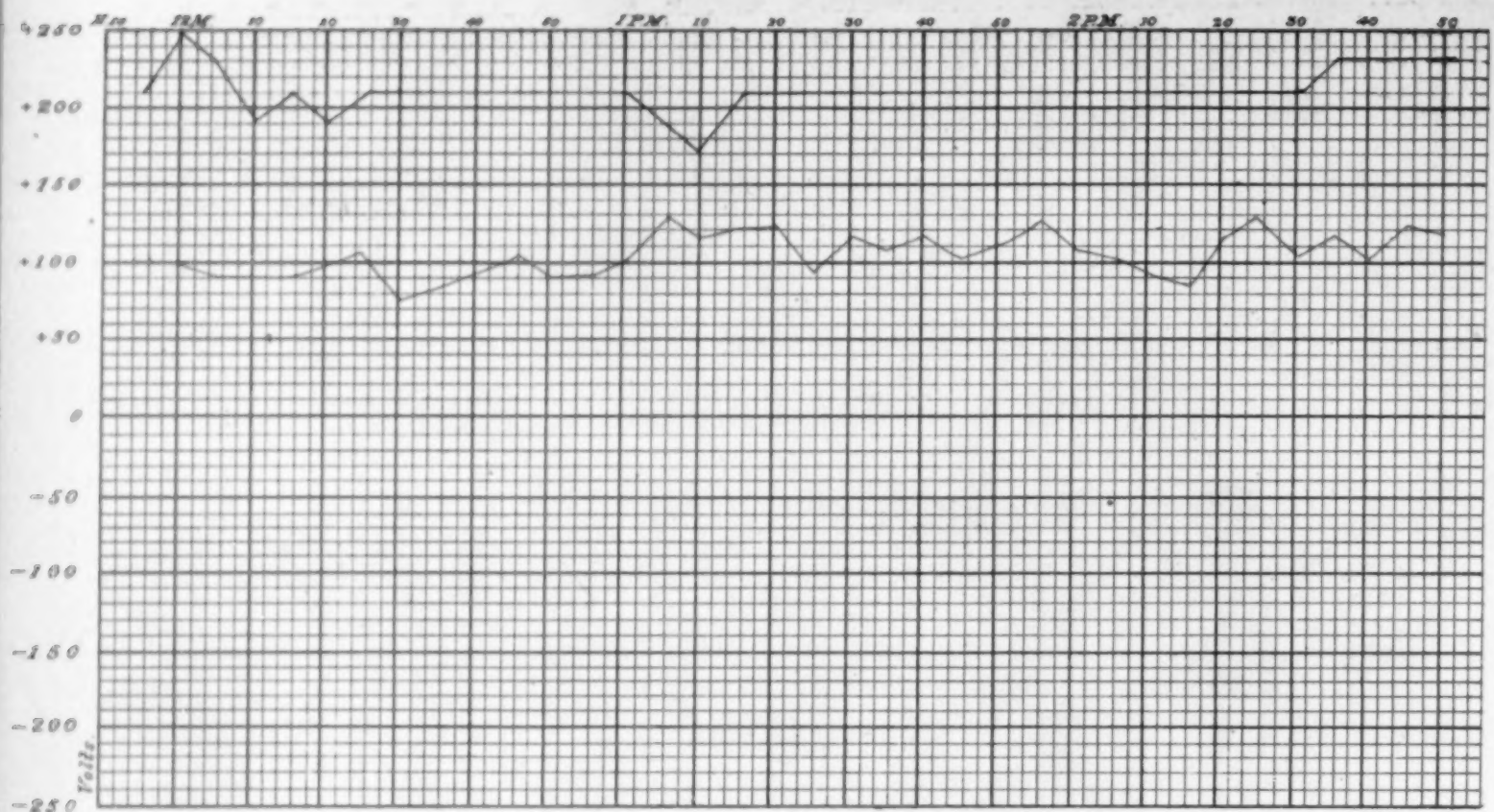
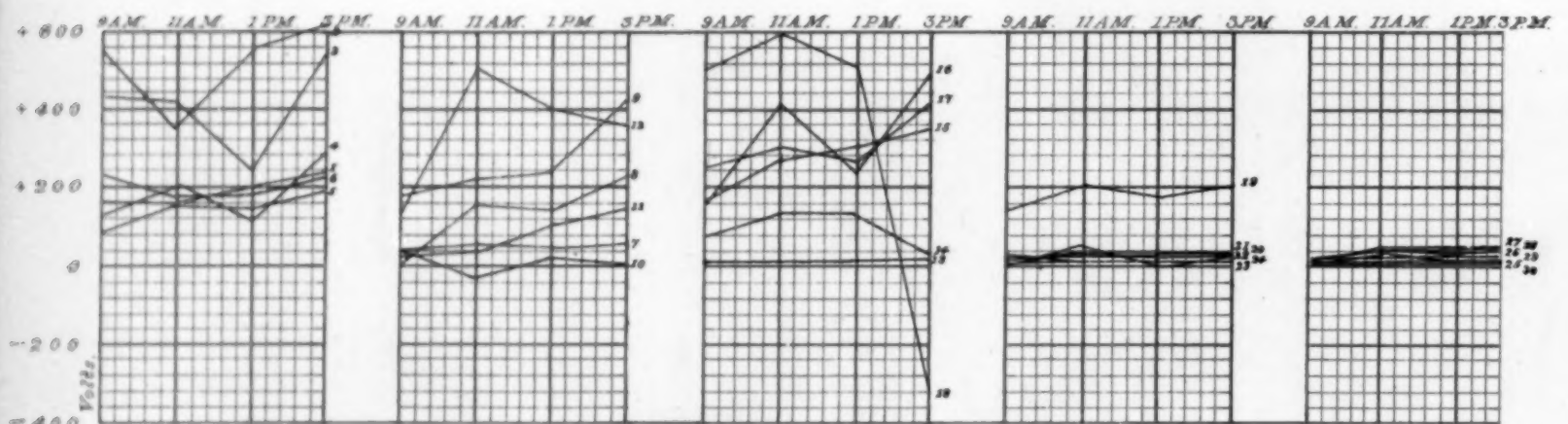


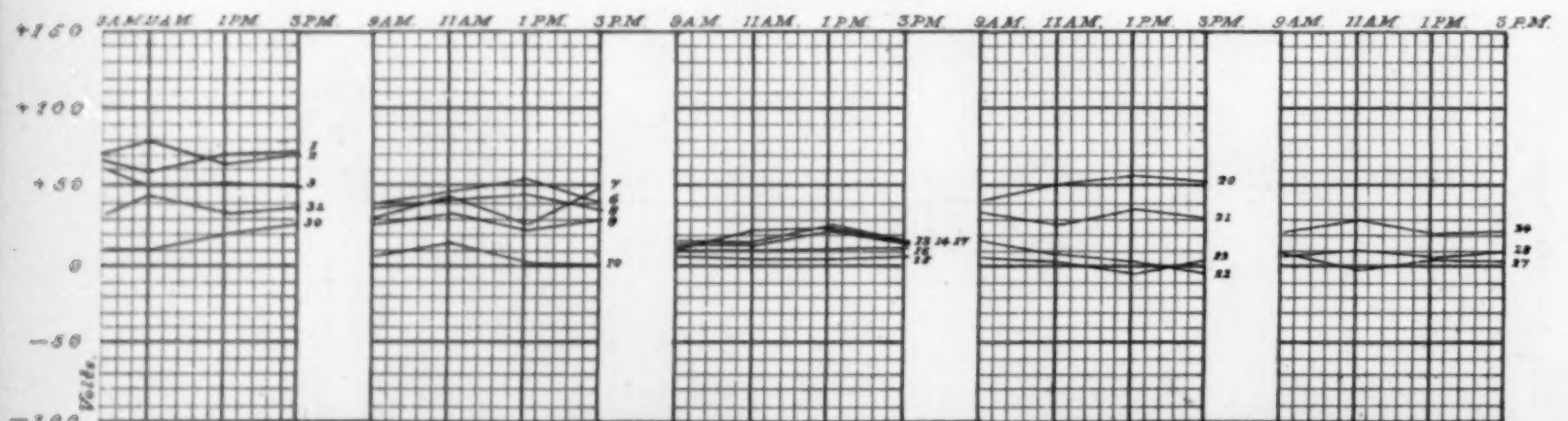
Chart VI. Curves showing Electrometer Readings.



September 21, 1886. { Monument ———  
Signal Office - - - - -



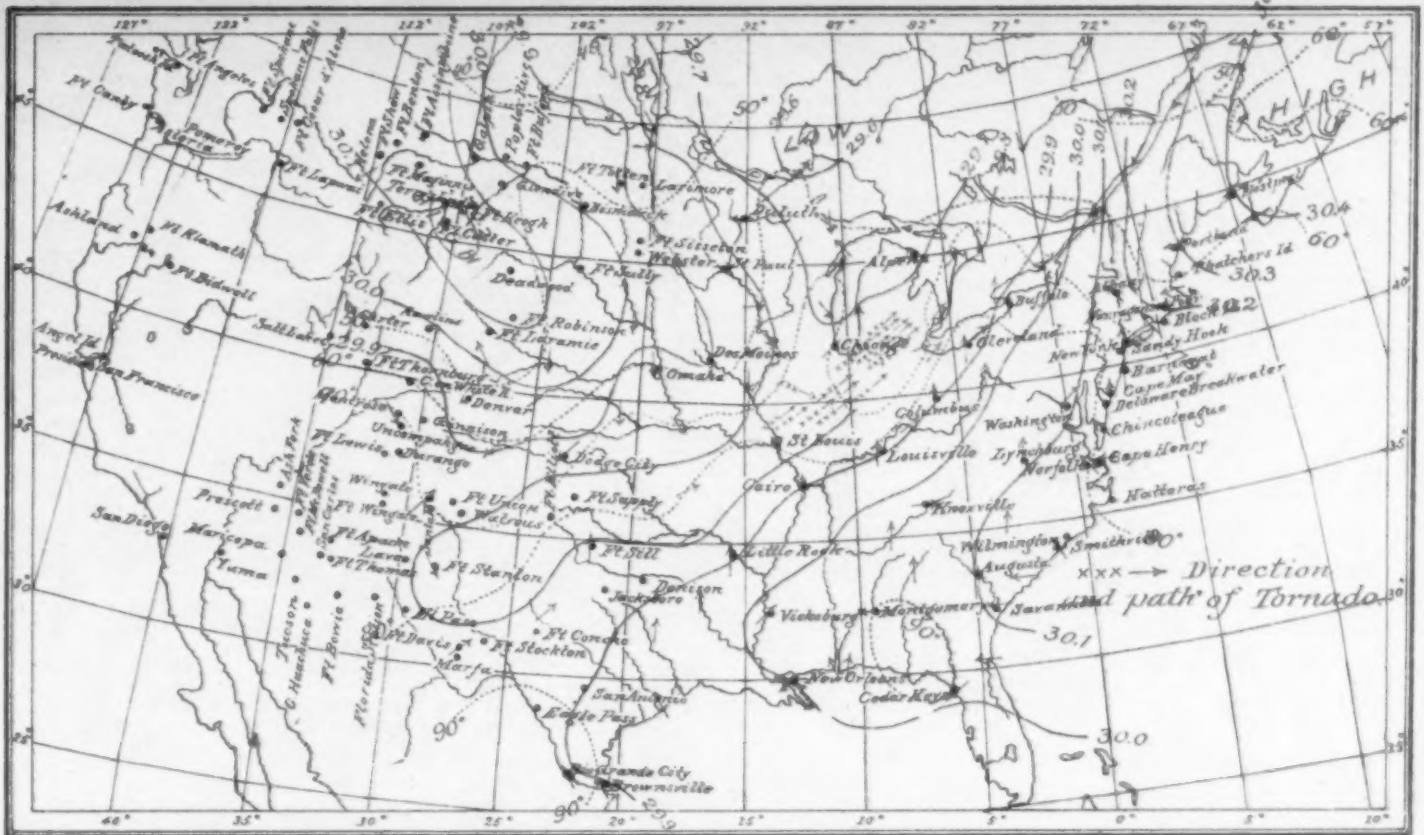
Boston, Mass., September, 1886.



Columbus, Ohio, September, 1886.



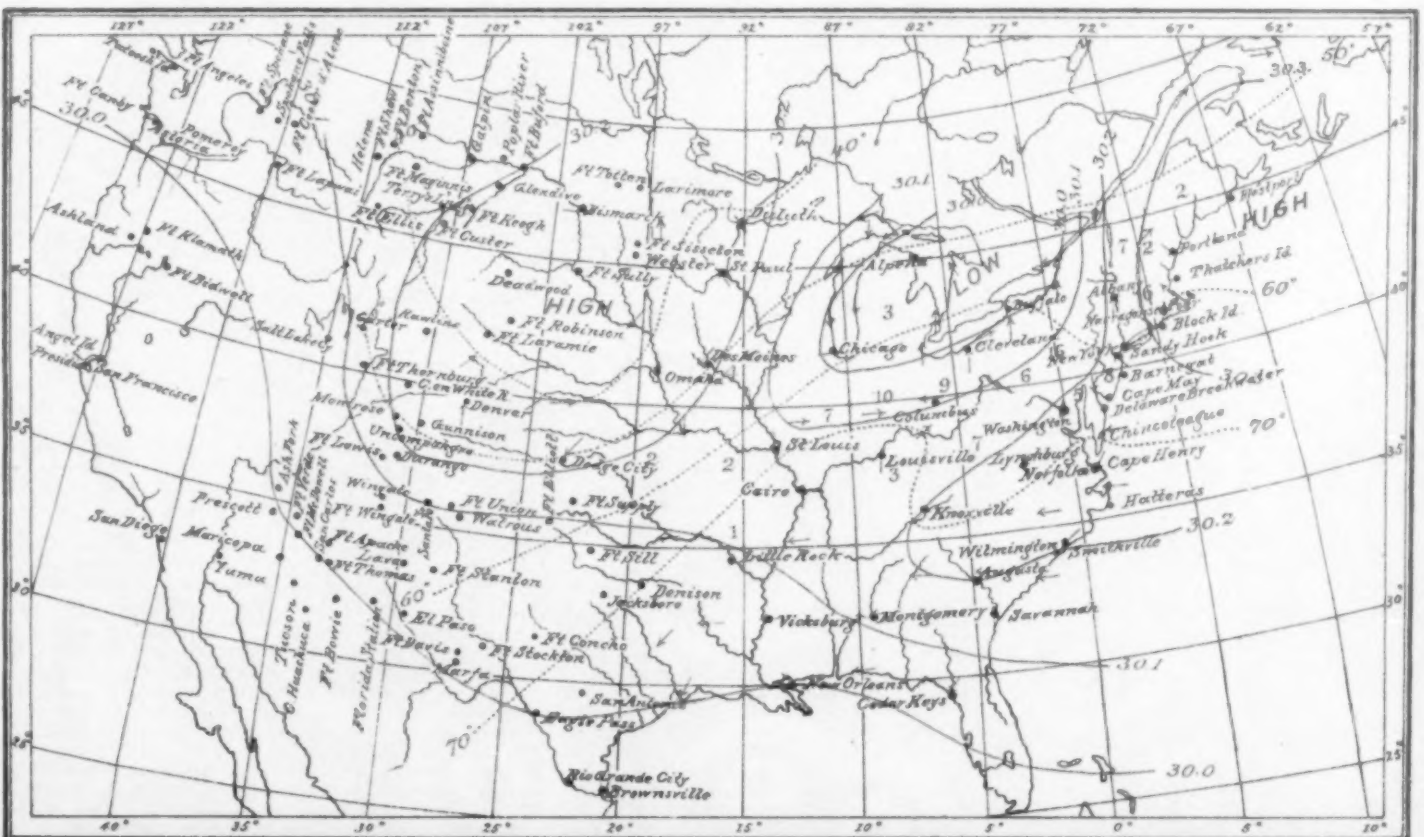
Chart VII. Isobars, Isotherms, and Wind Directions. 3 p. m. (Eastern time), September 16, 1886.



Signal Office Lith.

Chart VIII. Isobars, Isotherms, and Wind Directions. 7 a. m. (Eastern time), September 19, 1886.

Figures indicate the number of thunder-storms in each state on this date.



Signal Office Lith.





*Voluntary observers of the Signal Service, on land, from whom meteorological reports were received in time to be used in the preparation of the Monthly Weather Review for September, 1886.*

<i>Observer and place of observation.</i>	<i>Observer and place of observation.</i>	<i>Observer and place of observation.</i>	<i>Observer and place of observation.</i>
Anderson, Dr. W. W., Stateburg, S. C.	Dudley, C. B., Altoona, Pa.	Knapp, J. G., Limona, Fla.	Slide, Ellis, Somerset, Mass.
Altamir, J. M., Independence, Kans.	Duzy, J. B., Charleston, Ill.	Keece, G. Pomeroy, Cooperstown, N. Y.	Shriver, Howard, Wytheville, Va.
Adams, Dr. O. H., Vineland, N. J.	Deming, H. D., Wellsborough, Pa.	Kuhne, F. W., Fort Wayne, Ind.	Sonedecker, Rev. T. H., Titlin, Ohio.
Abbott, Dr. E. K., Salinas, Cal.	Dozier, Wm., Mattoon, Ill.	Ladshaw, G. E., Paolet, S. C.	Stunkard, L. E., East Brook, Pa.
Arents, Hiram, Oroville, Cal.	Dewhurst, Rev. E., Voluntown, Conn.	Lueps, Miss Anna, Manitowoc, Wis.	Sim, J. R., Summit, Va.
Adams, A. H., Fort Meade, Fla.	Day, Theodore, Dyberry, Pa.	Lincoln, A. T., Marion, Va.	Scribner, H. F. J., Stratford, Vt.
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